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## THE WIVELSFIELD AND BERMONDSEY RAILWAY ACCIDENTS.

THE report of the evidence given at the inquest on the bodies of those killed in the collision at Wivelsfield on the 23rd of last month, has inspired the leading journal to print a scathing article on the subject of signalling during the prevalence of fog, with special reference to the apparent want of supervision over those responsible for the executive work of dealing with traffic on the London, Brighton, and South Coast Railway; and, really, the evidence seems to point to a deplorable lack of organisation, locally, at least. When a station-master finds difficulty in obtaining fogmen, it would seem as though the duties were taken haphazard, and were not carefully allocated beforehand, and that the fogmen themselves had no standing instructions to present themselves for this duty, when the conditions obtaining made it necessary. When a signalman interprets a plainly worded rule to place detonators on the line near his box, when he knows the fogmen have not taken up their duties, into an instruction to place them beyond his distant signal, some hundreds of yards away, it looks like—an excuse. Too much may easily be made of the statement by the signalman at Keymer Junction that, in 36 years' service, he had never had occasion to put detonators on the line owing to the absence of fogmen, since the standard rules adopted by the railway companies, who are parties to the railway clearing system, give this rule with the qualification "when practicable." The neglect to provide a distant signal, indicating a line converging on another at the next consecutive signal, with the means of ensuring its position being conveyed to the drivers of passing trains, shows a marvellous disregard of the fundamental principles of train signalling. Having regard to the speeds of the more important trains, the distant signal is, probably, the most important of all, and its value is greatly enhanced during the prevalence of fog.

The position of the driver of the Pullman express is somewhat different. His rules direct, among other things, that if, during fog, or from any other cause, "the fixed signals are not visible *as soon as usual*, the speed must be reduced. . . . ."

The italics used in this extract do not appear in the book of rules, but attention is drawn to the assumption the words express. The assumption is that the driver knows his exact locality at all times. Is the assumption justified, when all the familiar landmarks are obliterated by fog? It is, of course, perfectly well known that different parts of the line will, in certain ways, give some indication to drivers, who know the route well, of their locality. The motion of the engine on curves is quite different to what it is on "the straight," quite independent of the direction of the curve; the sound emitted on passing over an iron bridge is quite distinct from that given by passage over a stone bridge; a stone cutting accentuates the sound to a greater degree and in a different way to an earth cutting

covered with grass; and the *swish* of the over-bridge and the less sibillant note of the arched culvert, or cattle creep, are peculiar to themselves. All these tend to remind the driver of his position—if he can keep them in consecutive order. It must not, however, be forgotten that, although these indications differ from each other, two of the same kind at different points on the route may not differ to an appreciable degree, and to be of service they must be recognisable in rotation, or they will be more dangerous than useful. Hence the question of localisation is of the utmost importance to a driver to enable him to obtain the momentary glimpse of the fogman's hand lamp, which is the only guide vouchsafed him when the signal is "off."

Some of the evidence given at recent inquests illustrates defects in the existing system which have been referred to more than once in these columns, and the results will not be so great a surprise as they seem to have been to the writer of the *Times* article, who writes as one having made an alarming discovery. The driver of the Brighton Pullman train expressed the opinion that, in the case of a fog which had been on some time, "any driver would depend on fog signals." In the Bermondsey evidence a conflict of opinion was evident between the signalman (whose duty it was to call out the fogmen, if *he* judged it necessary) and the driver of the train run into, and both were supported in their opinions by other witnesses. Another phase of the question was also shown by the driver, when asked if he considered the fogmen should have been out:—

"There had not been time; the fog came on too sudden," was the reply.

It would, however, be unfair to pronounce judgment on the reports of the evidence given at the inquests. The accidents will, no doubt, be the subjects of further inquiry by officers of the Board of Trade, who may be depended upon to sift the evidence thoroughly. The Brighton Company's officials may be able to throw further light upon the causes leading to the accidents, and to show that their management is not of so desultory a character as appears at first sight. Unless they are able to do this thoroughly, the uneasy feeling, of which the *Times* article is an expression, will be intensified.

Meanwhile, the evidence given should furnish lessons which it will be well for the responsible officials of all railways to study carefully. The first seems to be that the existing system of supplementary signalling during fogs is of a make-shift character, involving complex arrangements for which there is not always sufficient time, and the exercise of judgment on the part of those who are not in the best position to judge. The system, moreover, is one which, obviously, provides signals of an insufficiently precise and distinct character for the high rate of speed of the more important trains controlled.

A further conclusion, to which a study of the conditions obtaining irresistibly impels one, is that, whilst rules and regulations are excellent as a means of convicting delinquents, they are insufficient, in themselves, to avert disaster in all the curious combinations of circumstances which go to make a railway accident. To make rules, and to exact implicit observance of them, under all conditions, and by all classes of men, are entirely distinct operations, and the latter is by no means the least difficult; less dependence upon the observance of rules which are of infrequent application, and greater dependence upon apparatus would, possibly, give better results.

The suggestion of periodical examinations by the jury in the Wivelsfield case is just one of the suggestions that might be expected from a non-technical body of men, called upon to consider the circumstances and impelled to advance recommendations, without necessarily understanding the whole subject in all its bearings. Such a suggestion is opportunist, designed to meet the circumstances of one case only, without reference to the greater question of the suitability of the system as a whole, and is no more reliable, as a complete arrangement, than a contractor's surface line is to carry express passenger trains.

But, after all, the accidents themselves, deplorable as they were, the inquiries now the subject of comment, and those yet to be made, may have good results if the lessons they teach obtain adequate consideration. If, however, the results of the Board of Trade investigations are politely acknowledged, and carefully lost, or if undue prominence is given to the breaches of the rules, as the only contributing causes of the accidents, the results will hardly be satisfactory. If, on the other hand, the accidents afford an opportunity for the Board of Trade to call the representatives of the railway companies together for the purpose of considering alternative methods of signalling, either as a whole, or as supplements during exceptional conditions, and if a little judicious pressure be exercised, the question will be in a fair way for settlement. Uniformity of equipment in this respect is imperative, and admits of no argument; and it is for this reason concerted action is most desirable.

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**The Northern Society of Electrical Engineers.**—Mr. S. Joyce, the hon. secretary of this society, announces a special meeting of members to be held at the Grand Hotel, Aytoun Street, Manchester, on Wednesday evening, January 17th, 1900, at 7.30 o'clock, for the purpose of considering and adopting the proposed additions to the rules given below:—

To be added to the objects of the Society:—

4. In case the Society shall be discontinued or dissolved or shall be absorbed by or amalgamated with any other Institute or Society to dispose of the funds of the Society as the Council may determine.

New Rule, XXIXa, to be added:—

The Council may at any time at which they may think the same desirable arrange for the amalgamation or absorption of the Society with or by any other Society or Institution having similar or kindred objects on such terms and conditions as they may think fit, and may transfer to such Society or Institution the whole or any part of the funds of the Society, provided that it is made a term of such amalgamation or absorption that the members of the Society as enumerated in Rule IV. may join the other Society or Institution in the various grades for which they are respectively qualified without payment of any entrance fees. Provided that such amalgamation or absorption shall not be carried into effect without the proposal being approved in writing by a majority of the members of the Society. On such amalgamation or absorption being effected in manner aforesaid, and notice of the same together with a copy of the terms and conditions subject to which the amalgamation or absorption takes place being sent to every member of the Society as enumerated in Rule IV., the Society shall be considered as dissolved and be at an end.

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**Water-tube Boilers.**—"The modern water-tube steam boiler," remarked a well-known engineer, "has approached pretty close to the standard of perfection as a steam generator. The improvements possible to be made, and those that may be expected, are not primarily in the boiler itself, but in the methods of utilising the heat from the coal in the furnaces. There is great room for improvement in the construction of boiler furnaces, so that all possible efficiency may be obtained from the coal as it is burned, and so to distribute the hot gases as to do the most good. Compared with the intrinsic steam-making possibilities of coal, the proportion of gas generated and efficiently used has been but a small percentage of the whole. There are now on the market and in successful use five or six standard types of water-tube boiler, but even in the best of these there is room for a tremendous improvement in the furnaces and combustion chambers."—New York *Electrical Review*.

## THE CAUSE OF DEATH FROM ELECTRIC LIGHTING CURRENTS.

BY W. S. HEDLEY, M.D.

RECENT accidents at Bradford, Middlesbrough, and Bolton, once more bring under notice not only the electrical question of prevention, but the medical one of "first aid." With reference to the latter it must be regretfully confessed that we still look in vain for some simple, ready, and effective means of resuscitation after electric shock. In this respect there has been practically no advance since d'Arsonval, six or seven years ago, announced that persons suffering from electric shock ought to be treated as the apparently drowned —"Un foudroyé doit être traité comme un noyé"; in other words, by artificial respiration early begun and patiently continued. That the question has received no further solution is not because it has been left alone by medical men and physiologists, but because from the point of view of treatment there has as yet been no practical outcome of their labours. The latest contribution to the physiology of death by electric shock comes in the form of a painstaking experimental investigation by Dr. Robert Cunningham, of New York; but in the way of treatment he has nothing better to offer than the following admittedly impracticable procedure:—"After the electric current has arrested the circulation and the respiratory movements are no longer present, defibrinated blood is rapidly injected into the right carotid artery. At the same time blood is withdrawn from the right ventricle through the double cannula that has been passed down the external jugular vein after the current has been shut off. When enough of this dark venous blood has been collected, an assistant empties it from the bottle, defibrinates it, and filters it through glass wool, so that it may be again injected into the arterial system." Then follow further details of the method which, requiring as it does the immediate aid of an expert physiologist, with two or three skilled assistants, as well as an elaborate and delicate apparatus, is for practical purposes hopelessly out of court. But as an inquiry into the mechanism of death by electric shock, Dr. Cunningham's experiments are most interesting and instructive. By means of blood pressure tracings and other tests on dogs, with "the continuous finely pulsatory 116-volt current," he has satisfied himself that death from electric lighting circuits is due to sudden arrest of the circulation from fibrillar contraction of the heart; and in rare instances (when an electric current of considerable intensity and duration traverses only the cerebro-cervical portion of the nervous system) death may take place by asphyxia. To assign a proper value to these views, it is useful to bear in mind what has been said and done by previous experimenters.

D'Arsonval (1894) considered that an electric current produces death either (1) by the disruptive action of the current mechanically altering the tissues; or (2) that there occurs a central paralysis of respiration constituting a special form of asphyxia.

Dr. Tatum, of New York, experimenting in 1890, considered that such currents kill by acting chiefly or entirely on the actual substance of the heart itself.

Dr. Lewis Jones (1895) considered that death begins at the heart, and that the action of the current is upon the heart muscle rather than upon any of its nervous mechanisms.

Drs. Oliver and Bolam, following in the wake of these experiments, subsequently arrived at the same conclusion.

Dr. Bleile, of the Ohio State University, considered that death in such cases is entirely due to the fact that the current produces a contraction of the arteries through an influence on the nervous system; that is to say, through an effect on those nervous centres which control the diameter of the arteries; and that a constriction of the arteries so produced throws in an impediment to the flow of blood that the heart is unable to overcome.

The late Sir Geo. Johnston was of opinion that the fatal obstruction is not in the systemic arterioles, but is due to a constriction of the pulmonary arterioles, the latter being excited to contract by the entirely deoxygenised blood.

The present writer has in the ELECTRICAL REVIEW and elsewhere expressed the opinion that death may be brought about in some instances by arrest of respiration, in others by sudden and primary stoppage of heart action.

MM. Prévost and Batelli (March 13th, 1899), found that the current threw the heart into the condition known as "delirium cordis" or fibrillar contraction. Dr. Cunningham, as we have seen, although of opinion that death sometimes occurs from asphyxia, holds that death by direct action on the heart is vastly more frequent, and this, not because the muscular substance has been killed or paralysed by the current, but probably because the balance of the intra-cardiac co-ordinating mechanism has been destroyed. He considers that the instantaneous and total extinction of the arterial circulation which the blood pressure tracing shows, results from a "practically instantaneous cessation of the co-ordinated rhythmical contractions of the ventricles of the heart." In his experiments he found that usually a current of from 0·6 to 0·65 ampere was sufficiently strong when passed across the chest to kill the majority of the dogs whether large or small. He thinks that some other factor "apparently residing in the heart and probably physiological in nature," is also at work. The latter remark would probably apply to any kind of injury inflicted on any kind of animal. It is obvious that the effect of any form of violence to a living being must to some extent be determined by the physiological resistance of the individual.

The above experiments tend to prove: (1) That a dog may be killed by passing a strong continuous current for a more or less lengthy period (1·1 amperes for one minute) through the brain and upper part of the cervical spinal cord, the death in such a case being due to asphyxia; (2) That a weaker current for a shorter time (·3 ampere for six seconds) traversing the heart will, by sudden and permanent stoppage of the heart, produce death; and it is in this way that death usually occurs. In such cases the central nervous system dies from anæmia. It thus becomes evident that, to produce death in the shortest time, "the electrodes should be so placed that the greater part of the current passes through the heart." Then follow several practical hints on "humane" electrocution, which are not likely to prove of practical value, at least, in this country.

Physiologists have long been familiar with the condition known as "delirium cordis," or fibrillar contraction. The direct application to the exposed heart of battery currents, magneto-electric machines, and induction coils, have all proved able to induce this condition in the physiological laboratory, although such currents seem too weak to produce the effect by percutaneous application; but Dr. Cunningham observes that it is not remarkable that the stronger currents now under consideration should be able to do so. He states further, what is probable, but of which no experimental proof is adduced, that the "various kinds of alternating currents of moderate frequency, the intermittent and the coarsely pulsatory" currents of commerce produce this fibrillar contraction more readily than the smooth continuous current.

The further opinion is expressed that death by electric shock is not instantaneous, inasmuch as one nervous centre at least, viz., the respiratory, "continues to act more or less perfectly for some moments after the cessation of a lethal current." Having seen three cases, and read of 16 others, of recovery after electric shock, there seems to be "ample time before loss of consciousness occurs for the recipient of the shock to become fully aware of the fact that he is, or has just been, in contact with an electric current." Generally speaking, the sensation was described in these cases as not particularly painful, and resembling that produced by a strong medical coil. Usually a sensation of "tremendous pressure across the chest is also felt." The sequence of events in such cases seems to be somewhat as follows:—"As the accidental contact with the live wires, rails, brushes, &c., is made, more or less pronounced general muscular contractions immediately occur. After a deep inspiration and expiration respiration may perhaps stop, but soon begins again. Temporary arrest of heart action and fall in blood pressure is also immediately manifest. In slight cases the normal heart beat is soon recovered; but more or less syncope frequently occurs which disappears on the restoration of circulation. Where contact has been made with conductors carrying currents of considerable intensity, duration, and E.M.F., and the result does not prove fatal, "possibly none of the current, or undoubtedly but a very small portion of the current, traverses

the heart." But "when the current through the body is a strong one, for instance, one of from 1 to 8 amperes, and passes through the heart," fibrillar contraction ensues and spontaneous recovery is in the highest degree improbable.

## THE ELECTRO-CHEMICAL AND ELECTRO-METALLURGICAL INDUSTRIES IN 1899.

BY JOHN B. C. KERSHAW, F.I.C.

(*Continued from page* 31.)

### CHLORATES OF POTASH AND SODA.

THE year which has just closed has been marked by the completion of one new works for the production of chlorate by electrolysis, namely, the Bay City Works of the American Chemical Company. This company was promoted by the United Alkali Company, the company which controls the English chemical industry, in order to overcome the difficulties created by the high American tariff on chlorates, and manufacture was commenced at Bay City towards the end of 1898. The Hurter cell and process are in use at this new works, which is reported to be utilising about 1,300 H.P. in the production of chlorate.

The erection of the works at Little Wenlock, in Shropshire, to which reference was made a year ago, has been delayed, and the writer has been unable to obtain any information concerning the prospects of this company. The United Kingdom, which has been the chief centre of the chlorate industry for half a century, is, therefore, still unprovided with an electrolytic chlorate works, and it would appear that this industry is to be allowed to slip entirely out of the hands of English chemical manufacturers. The Scotch Water-Power Bill, which was promoted during the last session of Parliament, if successful, might have led to the establishment of such a works on the shores of Loch Leven. The defeat of the Bill has, however, indefinitely postponed the realisation of the plan for erecting an electrolytic chlorate works at that spot.

There are at present nine works in operation in Europe and America, where chlorate of potash is now, or in the past has been, produced by the electrolytic method. These are situated as follows:—Niagara (2), Bay City, St. Mickel, Bitterfeld, Rheinfelden, Golling, Mansboe, and Valorbes. These nine works have considerably over 33,000 H.P. available for the manufacture, and if necessary, could supply the whole world's demand for this chemical.

It is, however, doubtful whether their present output exceeds 6,000 tons, or about two-thirds of the annual production of chlorates, as the low prices obtained for chlorates of potash and soda in 1898 have caused many of the chlorate manufacturers to take up carbide manufacture. During 1899 the selling price of chlorates has been maintained fairly steady, a result due to an arrangement made between the chief European producers in the autumn of 1898.

The erection of one new factory for the production of chlorate is projected at the Ljungan Waterfall in Sweden, where 12,000 H.P. is said to be available. As the company for the development of this large water-power has only recently been formed, it is improbable that the new chlorate works will be operating before 1901.

With reference to the practical operation of the chlorate cell, the most important suggestion of the past year has been made by Müller. This investigator has discovered that the addition of a small amount of a soluble chromate to the electrolyte greatly facilitates the formation of chlorate, and also enables a much higher current efficiency to be maintained. It is probable that in time all electrolytic chlorate works will adopt this method of working.

The year which has just closed was signalised in May by a most disastrous explosion in a chlorate works at St. Helens, Lancashire.

Although the works were not operated by electricity, the lessons of this explosion will have to be closely studied by all manufacturers of chlorate, and it is therefore fitting that they should be noticed in this report. The explosion was caused by a fire which started in the re-crystallising house. Within 12 minutes of the outbreak of this fire the chlorate works were burnt out, and a neighbouring chlorate store was converted into a raging furnace. The explosion which then occurred utterly wrecked the buildings, killed five men, and wounded about 20 others, partially wrecked the gas works and a chemical works, and did an enormous amount of damage throughout the town. The Government inquiry which has since been held has revealed the fact, not known before, that chlorate of potash, when heated with sufficient rapidity, liberates its oxygen with explosive violence, and under such conditions becomes an explosive equal in power to ordinary gunpowder. It is therefore recommended that in future *no wood or other inflammable material* should be used in connection with the buildings or vessels in which chlorates are manufactured or stored, and also that iron should be used in place of wood for chlorate packages. The risks that are involved in neglect of these recommendations are so great, that we may expect to find all electrolytic chlorate works reconstructed during the next few years, and wood entirely banished from their fabrics.

### COPPER.

The chief event of 1899 in the electrolytic copper industry has undoubtedly been the enormous rise in the value of standard copper, a rise which attained its maximum point in May, 1899. In the last annual report upon the electro-chemical and electro-metallurgical industries, reference was made to the rise in value of copper from £48 in December, 1897, to £56 in December, 1898. The advance in value continued until May, when standard copper was quoted at £77 per ton, and electrolytic copper at about £84 per ton. This high level was maintained until the closing months of 1899, and it has led to a restricted consumption of copper in Europe, and has produced certain other evils which always result from the artificial stimulation of values. In a later issue the writer will deal more fully with the history of copper finance in 1899. For the present it is satisfactory to note that the New York syndicate which has fostered the inflation of copper values, has apparently lost its control of the situation, and during the last three months of 1899 the price of standard copper has fallen back to £70 per ton. All electricians will hail the prospective collapse of the New York syndicate with satisfaction, since cheap copper is an indispensable condition for the production of good and cheap work in the electrical engineering industry.

The number of electrolytic copper refineries has not been increased, so far as the writer is aware, during 1899; but there were several omissions in the numbers given in the last annual report, and the corrected estimate now stands as follows:—

America, 9; Germany, 7; France, 6; England, 5; Austria, 3; Russia, 3; Japan, 2; Australia, 1; with 5 works where the Elmore or Dumoulin processes for depositing copper are in operation, and one works where the Hoepfner extraction process is in use. The total is therefore 42.

No reliable figures for the output of these 42 copper depositing works can be given, but it is estimated that the total will be equal to 200,000 tons per annum. The aggregate copper output of the world in 1897 was estimated to be 396,728 tons, and in 1898, 434,329 tons, so about 50 per cent. of the world's supply of copper is now electrolytically refined. The latest available figures for the consumption of copper in Europe are those for 1898. The totals for the various countries are as follows:—

Germany, 101,518 tons; England, 106,000 tons; France, 55,000 tons; East Asia, 22,000 tons—total, 284,518 tons.

The totals for 1899 are not yet completed, but it is stated that the figures for the 10 months show a decrease in consumption of $22\frac{1}{4}$ per cent. in England, of $10\frac{3}{4}$ per cent. in Germany, and of $1\frac{5}{16}$ per cent. in France. This decrease is wholly attributable to the high prices which have ruled through the greater portion of the year.

In May, 1899, the long projected amalgamation of the various Elmore Copper Companies was effected, and a new company, the English Electro-Metallurgical Company, Limited, with a capital of £700,000, was formed to take over four of the existing companies. A working capital of £200,000 has been provided for the new company. There is now some prospect of financial success, especially as the French Company is said to be obtaining excellent results,

and to have made a gross manufacturing profit of £98,000 in 1898. The English Company, which owns and works the Dumoulin process for depositing tubes and other hollow ware, has not been as successful as was hoped, and, in its recently issued report, the board speak of mechanical and other difficulties.

Both these companies have made the manufacture of boiler tubes a speciality, but it is interesting to note that the Elliot Metal Company, of Birmingham, who own and work the Electrolytic Copper Refinery at Pembrey, South Wales, are producing a new alloy of copper for boiler tubes, which is said to possess advantages over pure copper, being tougher, harder, and more durable. The alloy contains pure tin and pure copper, but the percentage of each has not been published.

The influence of the high price of copper upon its use for electrical conductors, and the substitution in certain instances of aluminium for copper, has already been discussed under the heading of "Aluminium" in this report.

For some years the extraction of copper from its ores, by leaching and by electrolysis of the resultant solutions, has offered a problem which has attracted a large amount of attention. The difficulty has been that due to the presence of impurities in the solutions obtained, and to the effect of these upon the quality of the deposited copper.

Dr. Hoepfner has been one of the chief workers in this field of technical inquiry, and the writer was informed by him in July, 1899, that the Hoepfner process was then at work on an industrial scale at Papenburg, in Germany.

The history of industrial electro-metallurgy is, however, strewn with records of failure to extract copper from its ores in this way, and with the still more recent failure of the Ashcroft zinc extraction process before us, it would be rash to assume that Dr. Hoepfner has solved the problem of electrolytic copper extraction until the works at Papenburg have been in operation for a much longer period of time.

### HYPOCHLORITES.

The use of solutions of hypochlorite of soda prepared by electrolysis, for bleaching cellulose and cotton goods, is slowly extending in Germany, France, and Russia. In our own country the writer is still unable to report any progress; but a trial of one or other of the electrolytic bleaching processes will undoubtedly be made during the present year, as one of the large bleaching firms in the North of England has made all the preliminary arrangements for such a practical test.

All the processes for the electrolytic production of hypochlorites resemble one another in principle, and are based upon the electrolysis of a solution of common salt with insoluble electrodes, at a low temperature and without a diaphragm. The various forms of cell, however, differ in details of cell construction, and vary considerably in electrical efficiency.

It is wholly impossible to give at present any reliable estimate of the amount of power used for the production of hypochlorites by electrolysis, but the following facts relative to the adoption of the various cells and processes will show that electrolytic methods of bleaching are making progress in Europe.

The Kellner cell and process are in use at Golling, in Austria, at Charlottenburg and several other places in Germany, at Sarpsfos in Norway, and at a few places in Russia. According to a German authority, 700 H.P. is being used in Germany by the various firms employing the Kellner cell for production of bleaching solutions.*

The Vogelsang form of cell is stated to be in use at 22 factories in Germany, but no estimate of the H.P. utilised in these is available.

The Corbin cell and process are in use at Lancey, in France, while the Stefanow cell is stated to be at work at many places in Russia.

No records of any attempts to utilise hypochlorites for bleaching purposes in America have come under the writer's attention during 1899, but the Woolf process for production of a disinfecting solution from sea-water by electrolysis has been adopted at Havana, and a works, costing $50,000, has been built for operation of the process at this place. The plant was put into operation in July, 1899, and is stated to be a success, an improvement in the state of the harbour being already noticeable. The plant comprises engines and dynamos of 500 H.P., and can produce 160,000 gallons of disinfecting solution per day of 24 hours. The electrolysed solution contains 1·28 grammes free Cl per litre.*

It is not quite clear why the Woolf process should be a success in America, when the Hermite disinfecting process has failed in Europe; but doubtless the higher cost of bleaching powder and all chemicals in U.S.A. has had some influence upon the result.

With regard to the theory of hypochlorite production, Foerster and Jorre have published the result of researches upon the stability of hypochlorite solutions.† They find that the conversion of hypochlorite into chlorate is caused by other conditions than heat, and that the presence of free hypochlorous acid is one of these. In the absence of the free acid, solutions of hypochlorite are fairly stable, even at an elevated temperature.

Muspratt and Smith have investigated the limits of concentration for hypochlorite solutions, and have succeeded in obtaining liquids containing 500 grammes free Cl per litre, though not by electrolytic methods.‡ They find that two of the chief hindrances to the production of such solutions are the presence of ferric oxide and of carbonic acid as impurities in the original salt solution.

These researches are not without their bearing on the electrolytic production of hypochlorites upon an industrial scale, and they should be studied by all chemists engaged in this industry.

*(To be continued.)*

* *Dingler's Polyt. Journal*, January 7th, 1899.

## REFUSE AND ITS CALORIFIC POWER.

BY ED. C. DE SEGUNDO, Assoc.M.Inst.C.E.

THE paper by Mr. Newton Russell recently read and discussed at the Institution of Civil Engineers revives a subject of great importance to every member of the community. The hygienic disposal of town's refuse is of the highest importance to the health of the inhabitants, and should have a far greater claim upon the attention of sanitary authorities than upon that of the electrical engineers. Whether or not the means selected for its disposal result in utilisable bye-products should be quite a secondary consideration. When the possible utilisation of the heat of destructors was brought forward some years ago, the class of mind that seeks to make money by any and all means was not slow to discover in the utilisation of town's refuse a means of fleecing the public by holding out dazzling prospects based upon the catch word "gold from the dust-bin." The boom in the production of refuse destructor companies, and its inevitable results, are within the recollection of us all, and the disastrous consequences of the working of some of these companies have discredited the subject of the utilisation of town's refuse to such an extent that it has been very difficult of late years to persuade the vestries and local authorities to treat the matter seriously at all.

In 1888 the Local Government Board instructed Colonel Thomas Codrington to make a report upon the subject. This report is most instructive and useful, and on careful perusal it becomes abundantly evident that the heat evolved by the burning of town's refuse cannot be looked upon in any other light than that of a bye-product extremely variable in amount, and that the results obtained in one locality are no criterion of what will be achieved in another.

Undoubtedly, in residential districts, a considerable proportion of dust-bin refuse will consist of cinders and half-burnt coal and other combustible material. In manufacturing districts the waste products of the factories, which may be combustible or the reverse, will enter largely into the composition of the refuse. In agricultural districts the refuse will be of a character that could hardly be expected to contain the thermal value necessary to burn itself. Such refuse, of course, would contain a very large proportion of

* *Electrical World*, October 7th, 1899.
† *Journal fur Prakt. Chemie*, 1899. Vol. 50, p. 53.
‡ *J. Soc. Chem. Industry*, December, 1898. March, 1899.

moisture, but the percentage of moisture is always considerable, and from experiments made at Bradford, Leeds, and Whitechapel it was found, from the results of 23 trials in October, 1887, that the moisture varied from 29 per cent. to 93 per cent. This moisture exerts a very great influence upon the calorific power as distinguished from the calorific value of refuse.

An investigation of the calorific power of refuse accentuates the impossibility of such claims as were frequently advanced not so long ago in regard to evaporative power. Let us consider for a moment refuse showing 93 per cent. of moisture, the maximum found in Col. Codrington's tests. Assuming that the moisture is evaporated at atmospheric pressure, and neglecting any further heat which it may carry away in mingling with the waste gases, the heat required per pound of this refuse to get rid of the moisture would be 0·93 lb. × 1,100 Th.U., or 1,023 Th.U. Now, some proportion of the remaining 0·07 lb. of refuse must be combustible, but supposing it to be composed entirely of combustible, and making no allowance for heat carried away in the waste gases or in fusing the clinker, the calorific value thereof would have to be $\frac{1,023}{0\cdot07}$, or 14,600 Th.U. per pound, in order that this refuse should be capable of burning itself. It is clear, upon the face of it, that such refuse cannot be burnt without the aid of other fuel. Now let us turn to the result claimed by Mr. Newton Russell in his recent paper: "Combined Refuse Destructors and Power Plants." He puts the average moisture at 20 per cent., and the amount of incombustible at 32·8 per cent. This leaves 47·2 per cent. as the amount of combustible matter from which all the heat must be derived per pound of refuse. He further states that the average evaporation is 0·99 lb. water from and at 212° per pound of refuse.

A pound of good coal of calorific value 14,500 Th.U., contains enough heat to evaporate about 15 lbs. water from and at 212°. The quantity of air theoretically necessary for the complete combustion of a pound of such coal, containing 88 per cent. of carbon, would be about 12·5 lbs., and the amount of air per pound of such refuse as the above would be between 2 and 3 lbs. Assuming that a modern well-designed destructor requires 1½ times the amount of air theoretically necessary for the complete combustion of the refuse, it may be taken that the actual amount of air passing through the furnace would be between 3 and 4½ lbs. per pound of refuse burnt. Putting it at 3·5 lbs., the heat account would be as follows:—

| | |
|---|---|
| Heat lost in waste gases, say, 600° × 0·23 Th.U. (sp. ht. of gases) × 3·5 lbs. ... ... ... ... ... | 484 |
| Heat lost in clinker raised to, say, 1,000° in furnace from 60°, 0·328 × 940 × 0·2 ... ... ... ... ... | 61 |
| Heat lost in evaporation of moisture, 20 per cent. of 1,100 Th U.... ... ... ... ... ... ... | 220 |
| Heat absorbed in 0·99 lb. water from and at 212° ... | 957 |
| | 1,561 |
| Radiation, say, 5 per cent. ... ... ... ... ... | 75 |
| | 1,797 |

These 1,797 Th.U. have to be supplied by 0·472 lb. combustible, which must therefore have a calorific value of $\frac{1,797}{0\cdot472} = 3,800$ Th.U. per pound.

Colonel Codrington found the average moisture in the Bradford refuse to be 47 per cent., and the amount of incombustible to be 33 per cent.; therefore, only 20 per cent. was combustible. In this case the figures would be somewhat as follows:—

| | |
|---|---|
| Heat lost in waste gases, say... ... ... ... ... | 250 |
| Heat lost in clinker ... ... ... ... ... ... | 61 |
| Heat lost in evaporating moisture, 47 per cent. of 1,100 Th.U. ... ... ... ... ... ... ... ... | 517 |
| Radiation, say ... ... ... ... ... ... ... | 75 |
| | 903 |

Nothing is stated as to any steam having been raised by the burning of this refuse; but, as only 20 per cent. is combustible, it would be necessary for this to have a calorific value of $\frac{903}{0\cdot20}$, or 4,515 Th.U., in order to supply enough heat to burn itself.

As one more example, let us consider the results of a test of the Horsfall destructor at Oldham by Lord Kelvin.

Here the proportion of moisture was about 30 per cent., that of clinker about 33 per cent., and the air per pound of refuse 2·06 lbs.:—

| | |
|---|---|
| Heat lost in waste gases, say, 600° × 0·23 × 2·06... ... | 285 |
| Heat lost in clinker ... ... ... ... ... ... | 61 |
| Heat lost in evaporating moisture, 30 per cent. of 1,100... | 330 |
| Heat absorbed in evaporation of water, 1·06 × 966 ... | 1,024 |
| | 1,700 |

So the 37 per cent. of combustible must in this case have a calorific value of $\frac{1,700}{0\cdot37}$, or nearly 4,600 Th.U.

Now this is about one-third the thermal value of pretty good coal, and it is difficult to realise that cinders and ashes, mixed with animal and vegetable refuse, glass, rag and bone, broken pottery, old metals, paper, straw *et hoc genus omne* can produce a fuel having a constituent possessing one-third the calorific value of good coal. We are, however, confronted with figures in the last example obtained by a very high authority, and which as far as can be gathered are unimpeachable.

To yield results from which one might generalise with accuracy, destructor trials should be extended over a full year, observations being taken at sufficiently frequent intervals to obtain a trustworthy average value of the nature of the refuse.

It must be borne in mind that results obtained in trials extending over a period which in a steam engine trial would be considered ample, would be considered wholly inadequate for the proper determination of the average calorific value of town refuse. Coal is coal all the year round, but refuse varies in quality and in composition with the season of the year, and the amount of moisture depends upon the weather and upon the mode of collection.

Refuse, as a fuel, cannot but be unsatisfactory, as no two loads are alike in composition, and the variation of the pressure in steam generated from the heat of refuse furnaces is often very great, nor can it be otherwise, and even a thermal storage system cannot completely correct the economical evils arising therefrom. In short, a refuse destructor should not be expected to be an efficient or reliable heat producer. The first duty to be performed is to well and sufficiently consume or cremate the refuse of the district in such neighbourhoods as admit of no better or simpler method of its disposal, and the utilisation of any heat so produced must be considered as purely adventitious. Such a view naturally suggests a consideration of the relative costs of burning and of other means of disposal. On this point Col. Codrington's report is interesting. The net cost of burning refuse, including a charge for repayment of principal and interest on the cost of the works, varies from 2½d. per ton to 2s. 3½d. per ton, the variations being mainly caused by the existence or otherwise of a market in the neighbourhood for the sale of mortar manufactured from the clinker.

Mr. Russell states that the cost of destruction is 2s. 5d. per ton, and that this is less than that at which the refuse could be barged away in London. It is certain that at least one Vestry has found it cheaper to barge away refuse than to burn it. In the Spring of 1898 it was reported by the Vestry of Battersea that during the last nine months the use of the destructor had been discontinued and that a saving of *£1,600* had been effected in spite of the fact that only one barge was available. In Mr. Medhurst's report to the Fulham Vestry in 1896, the cost of barging was put at 2s. 3d. per load. Now, as a load varies in weight from 15 cwt. to 1½ tons, it is difficult to say what 2s. 3d. per load works out at per ton, but taking the mean weight as being 22½ cwt. per load, then the cost of barging away from Fulham would work out at 2s. per ton. At Leeds the cost in 1888 was stated to be 1s. 3d. per ton delivered at the destructor. In 1896 it was reported that during the previous three years' working 181,645 tons had been burnt at a total cost, including interest on capital, but excluding superintendence, of slightly over 2s. per ton.

The subject is one upon which no very comprehensive and reliable data have as yet been collected, no doubt because for the reasons set forth above, the trials necessary to obtain

such results would be tedious and expensive. At the same time it is to be regretted that more lengthy trials have not been carried out by the various authorities using destructors, as the results would be of the greatest value to others considering this very important question.

## RECENT PAPERS ON THE COMMUTATION OF THE DIRECT CURRENT DYNAMO.

THORBURN REID.—"Sparking, its Cause and Effects": read at the meeting of the American Institute of Electrical Engineers, December 15th, 1897.
T. FISCHER HINSEN.—"Observations of Methods of avoiding Sparking in Continuous Current Machines." *Elektrotechnische Zeitschrift*, December 30th, 1897.
EUSTACE THOMAS.—"Sparking in Dynamos." The *Electrician*, February 18th, 1898.
H. N. ALLEN.—"Sparkless Reversal in Dynamos." *Journal of the Institution of Electrical Engineers*, April, 1888.
W. H. EVERETT and A. H. PEAKE.—"Experiments on Commutation in Dynamos and Motors." The *Electrician*, April 22nd, 1898.
W. H. EVERETT and A. H. PEAKE.—"The Effect of Commutation on the Field of Dynamos and Motors." The *Electrician*, December 30th, 1898.
E. ARNOLD.— *Elektrotechnische Zeitschrift.*
G. KAPP.— *Elecktrotechnische Zeitschrift*, 1899.

§ 1.—During the last two years a large number of experiments and papers have been published on the commutation of the direct current dynamo. So far as a complete solution is concerned the problem seems to be very much where it was left by Mr. Swinburne's paper, read before the Institution of Electrical Engineers in 1890; but the conditions are now well understood by a large number of engineers, many more dynamo makers can produce machines which substantially meet requirements, and partial solutions have been proposed by Sayers, Ryan, Mordey, and others. The practical importance of the problem is continually increasing, so that a complete solution would repay a very large expenditure of time and money; to this is due the energetic study from which these papers have resulted. A general account of this work is most easily given by taking the various points of the problem in order, and referring to the different articles in the course of it.

§ 2.—Commutators are commonly said to be damaged in two ways. If the current flowing from the brush into part or the whole of a commutator bar is excessive, the surface is heated in consequence of the contact resistance, the copper is fused and dragged away by the brush and the commutator becomes rough and scored. This effect occurs during the time that the bar is in contact with the brush. Or if there is a considerable current flowing between the brush and the bar, and a corresponding difference of potential between them, at the instant when they separate, an arc is formed between the trailing edge of the bar and the toe of the brush. The injury caused by this arc takes place during a short period after the bar has left the brush.

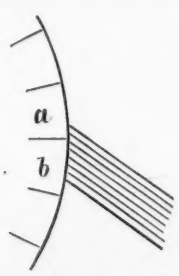



FIG. 1.

As to the first cause of injury, it is clear that the best possible condition for avoiding this is, that the current flowing from the brush into the commutator shall be uniformly distributed over the whole of the surface in contact, so that where a brush covers several bars the current flowing into each bar is proportional to the area of each in contact with the brush. Thus, suppose in the case of fig. 1, one-fifth of the brush rests on segment *a*, and four-fifths on segment *b*, the collection will be the best possible if one-fifth of the current flows into *a*, and four-fifths into *b*. This obvious proposition was very clearly laid down by Mr. Thorburn Reid in his paper as the fundamental condition for good commutation, and the problem may be treated as one for ascertaining the means of producing this effect. If the flow of current from the brush into the commutator is evenly distributed, it is clear that all the commutator bars under the brush must be at the same potential, differing only from the potential of the brush itself by the product of the total armature current and resistance of the contact surface. The condition, then, for perfect collection, is that every commutator bar shall remain at one and the same potential during the whole time that it is under the brush. It is clear that this condition also meets the case of the second cause of sparking, *i.e.*, the formation of an arc at the toe of the brush, since there is then no difference of potential between a bar leaving the brush and the brush itself, other than the small quantity determined by the resistance of the contact surface; while the current passing between them at the instant of breaking contact is *nil*.

The maintenance, then, of each commutator bar at one potential during the whole of the commutation period may be treated as the one necessary condition for perfect commutation.

§ 3.—The conditions for obtaining this result are easily stated. To take a simple case, consider fig. 2, a diagram of

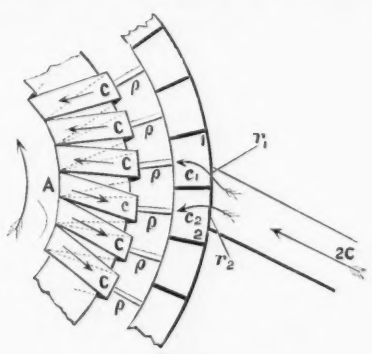



FIG. 2.

part of a ring armature revolving in the direction of the large arrow. The total armature current is 2 C, of which half flows away from the brush in each direction round the armature. The brush in this case is drawn the width of one commutator bar, so that it never touches more than two bars at once, and only one coil is being commutated at a time. $c_1$ $c_2$ are the currents flowing from the brush into the two bars under the brush, and $c$ is the current in the convolution A which is being commutated: so that

$$c_1 = C + c, \quad \text{and } c_2 = C - c;$$
$$\text{or } 2C = c_1 + c_2, \text{ and } 2c = c_1 - c_2.$$

When the leading edge of bar 2 first comes to the heel of the brush, the current $c$ in the convolution A has the value C. When half of the brush is on bar 1, and half on bar 2, if the commutation is perfect the current flowing into the brush is equally divided between the two bars, so that $c_1 = c_2$, and $c = o$. When bar 2 leaves the brush the current in A is again C, but in a reversed direction, so that $c = -C$. This gradual reduction of the current in A from C to zero, and its subsequent increase to C in the opposite sense, constitutes the process of commutation, and if this takes place at a uniform rate, and is exactly completed during the commutation period, the commutation is perfect, and, given proper dimensions to the brushes and commutator, is sparkless. It should take place at a uniform rate because the area of the contact of each bar changes uniformly, and it must be complete at the end of the commutation period, or an arc must necessarily be formed. Fig. 3 represents this conclusion diagrammatically. Here the ordinates of the line *a b o d e* represent the value of the current in the convolution A, and the abscissæ the time: *m* represents the moment when bar 2 (fig. 1) first reaches the heel of the brush; *o* the moment when the brush rests half on bar 1, and half on bar 2; *n* the moment when bar 1 leaves the toe of the brush.

The period *m o n*, which elapses while the insulating plate between two bars is moving under the brush, is the commutation period. The current in A has the uniform value C up to the point *b*; during commutation this is gradually reduced and reversed, and after the point *d* the value − C is maintained. The condition for perfect commutation is that this line *b o d* shall be straight. If the commutation is imperfect the current in A may take such a course as the dotted line *b f g*, the excess of the current to the left of *d* producing

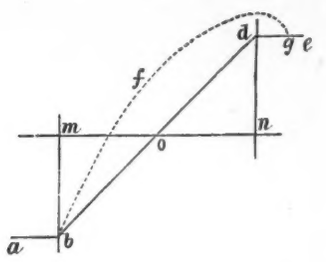



FIG. 3.

excessive heating of the surface of the bar, and the excess to the right of *d* producing an arc at the toe of the brush. Messrs. Everett and Peake observed the history of the current in the commutated coil of a dynamo in the laboratory of University College, Nottingham, and gave diagrams of it in the first of the two papers referred to above. The curves departed widely from a straight line in several cases, but in one (curve Q of fig. 4 of their paper) the commutation must have been very nearly perfect.

§ 4.—Consider how the magnetic flux through the convolution A must change during commutation in order to reverse the current in this particular way. The conditions to be met for perfect commutation are that the current is to change uniformly during the commutation period from a value C to a value −C, while the ends of the convolution, *i.e.*, the two commutator bars, are to remain always at one constant potential. These require that the magnetic flux through the coil is to change continually during the commutation period, and at a rate which at each instant is proportional to the current flowing in it. Thus if the value of the current in A at any instant is *c* and the resistance of the convolution is R, the flux through the convolution at that instant should be changing at a rate *c* R.

If in fig. 4 the ordinate of the line *a o b* represents on some scale the value of *c* R for perfect commutation during

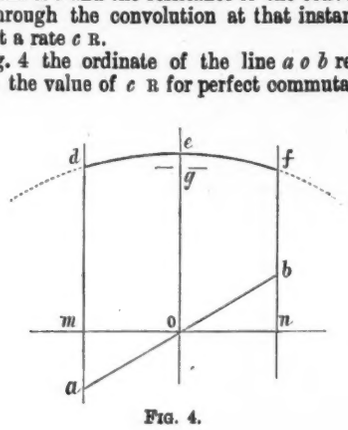



FIG. 4.

the commutation period *m n*, and consequently the rate of change of magnetic flux in the convolution, the value of the flux itself will be represented by a parabola *d e f* which has the property that the tangent of its inclination to the axis is at every point proportional to the corresponding ordinate of *a o b*. This curve is symmetrical about *o e*, and shows that the flux through the convolution should be the same at the end of the commutation as it was at the beginning, and should have a maximum value in the middle of the period. The ordinates of *d e f* represent armature flux in a sense opposite to that of the rotation of the armature in fig. 2.

The form of the line *a o b* of fig. 4 as it occurs in actual machines has been determined by several observers. Messrs. Everett and Peake's paper of December 30th, 1898, contains several examples of this of very great interest, and others are given in Mr. Allen's paper in the *Journal of the Institution of Electrical Engineers* of April, 1898.

§ 5.—It is easy to see that these conditions are not affected by the fact that the brush covers several commutator bars. In every case of perfect collection the potential of each commutator bar does not change so long as it touches the brush, and the reversal of the current in a commutator coil takes place uniformly during the whole commutation period.

§ 6.—The change of flux in the coil under commutation during the commutation period is the sum of two effects. One of these is the result of the movement of the coil in the magnet field, and the other is the result of the change of the current flowing in the coil itself and in neighbouring coils undergoing commutation at the same time. The flux due to the current in the armature coils, other than those which are being commutated, is small, does not change much during the commutation period, and need not be taken into account in this connection. The case where only one coil is commutated at a time has been chosen here to simplify the statement. Fig. 6 is a diagram of part of the magnet field of a dynamo,

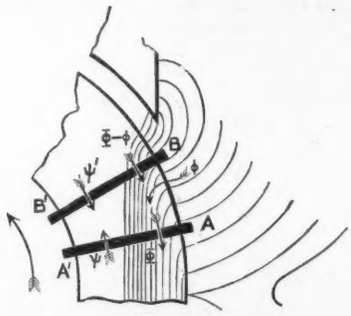



FIG. 6.

where the fine lines represent the flux due to the field magnet. A A′, B B′ are the positions of the commutated coil at the beginning and end of the commutation period. When the coil is at A the current flowing through it is C in the direction A′ — A; when at B the current is again C but in the sense B — B′. If the flux through A A′ due to the magnet system is Φ in the sense of the arrow so marked, and the flux entering from the stray field between A and B is $\phi$, then the flux due to the magnet field through B B′ is $\Phi - \phi$. The flux through A A′ due to the current flowing in it is shown by the arrow marked $\psi$ and is opposed to Φ. That through B B′ due to the current is the arrow $\psi'$, and is in the same sense as Φ. If the flux through the coil is the same at A A′ and B B′, the necessary condition for perfect collection, $\Phi - \psi = \Phi - \phi + \psi'$, and $\phi = \psi + \psi'$. It is commonly assumed that $\psi$ and $\psi'$ are equal to one another, and to quantity $l$ C, where $l$ is independent of C. It seems to be a legitimate assumption for this purpose, but it should be remembered that it is only approximately correct subject to certain conditions. Mr. Allen's paper in the *Journal of the Institution of Electrical Engineers* gives a great deal of information on the value of this quantity $l$ for various positions of the coil. For perfect commutation we may say that the flux entering the armature in the commutation space is proportional to the current, and write $\phi = 2\,l\,C$.

§ 7.—As to the distribution of the flux $\phi$ between A and B. The curves of fig. 7 show the relations between the two component parts of the flux which change in the coil during its passage through the commutation arc from A to B. The ordinates of curve I. measured above A B give the total flux in the coil at each point, which was shown in § 4 to follow a certain parabolic law. This flux is the sum of that due to the current in the coil undergoing commutation, shown by the ordinates of II., and that due to the main magnet field shown by curve III., which is the quantity $\phi$. If the last curve were a straight line, it would show that the distribution of $\phi$ (of fig. 6) should be uniform. It is, however, an arc of a parabola, and shows that the field $\phi$ ought to be least dense near A at the beginning of commutation, and more dense near B, which is the character of the actual field of a dynamo.

§ 8.—The relative importance of these quantities and the amount by which the curve III., fig. 7, deviates from a straight line may be realised from a practical illustration.

Consider a machine having an output of 200 amperes at 100 volts at 600 revolutions, with 50 sections on the armature, and 2 convolutions to the section. Then if the brush is the width of one section, the commutation period is ·002 second, and the total armature flux is 10,000,000 lines; *i.e.*, 5,000,000 through each side of a ring armature near the commutation point. In fig. 7 A B represents ·002 second, and A *e* represents 5,000,000 lines. Suppose the resistance of each armature section to be ·0001 ohm. Then in fig. 4 *m n* is ·002 second, and *a m* or *b n* represents such a rate of change of flux through a coil of two turns as will drive 100

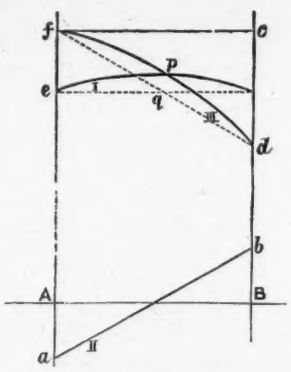



FIG. 7.

amperes through a resistance of ·0001 ohm, *i.e.*, a rate of change of 500,000 lines per second. Then the areas *o a m*, *o b n*, and the height *e g* each represent a total flux of 250 lines. This is the total quantity by which the flux through the coil is to be first increased and afterwards diminished during the commutation period of ·002 second to effect perfect collection and is represented in fig. 7 by the length *p q*.

Consider next the change of flux due to the reversal of the current in the section. Mr. H. N. Allen found the inductance of a single turn on the armature of a small Immisch motor with a commutation period of ·0025 second to be about $8 \cdot 10^{-7}$ henrys. With the larger armature of our example we may assume that the reversal of 100 amperes in a coil of two turns would produce a change of flux of at least 200,000 lines. In fig. 7 A *a* and B *b* each represent 100,000 lines, and C *d* represents 200,000 lines. It is evident that where *p q* = 250, and *e f* = 100,000 the curvature of the line III. is practically insignificant.

§ 9.—The case where the brush covers several sections of the commutator may be considered with reference to fig. 8,

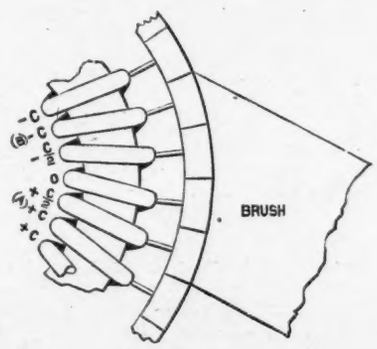



FIG. 8.

where the brush is drawn of the width of four sections. The coil A is just about to enter the commutation arc, and the coil B has just left it with its current fully reversed. The currents in the three intermediate coils are in the process of reversal, and the magnitude of the current in each coil is marked at the side of it. If the flux in the armature due to one of these coils having a current *c* is *l c*, it may be seen that the flux in coil A may be represented approximately by 4 *l* C in one direction, and that in B by 4 *l* C in the other direction. The change of flux between the positions A and B is then 8 *l c*, and if the flux is to have the same value at the end of the commutation period as at the beginning, the rate at which this flux has to be introduced from the magnet field has exactly the same density as when the brush was only the width of one section. This indicates that commutation cannot be effected in a weak field by the device of a thick brush.

*(To be continued.)*

## SURFACE CONTACT SYSTEM AT TOURS.

AN interesting surface contact system of electric railways has been in operation for several months in Tours, France, which is the first practical application of the Diatto surface contact system with underground conductors. These lines have run uninterruptedly since they were opened for traffic and their operation is reported to have given entire satisfaction. The Tours tramways comprise a number of urban lines having an aggregate length of 12 km., approximately, and suburban lines to Luynes, Saint Avertin, and Vouvray. The Diatto system is installed only in the heart of the city, the remainder of the lines being equipped with the overhead trolley system. The power house contains four boilers having a heating surface of 165 sq. m. each, giving 2,000 kg. of steam per hour. There are three simple condensing engines of 300 H.P., each belt connected to a generator of 200 KW. capacity, giving currents at 550 volts pressure. The system

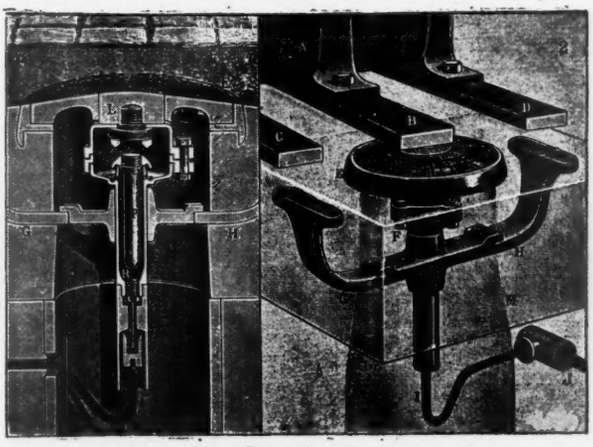


FIG. 1. FIG. 2.

of distribution, which is described in *La Nature* (a translation appearing in the *Street Railway Review*, of Chicago, from which we reprint this article), is comprised of cables buried directly in the ground, from which are connected all the branches which operate through the surface contacts. For some previous notes on a prior Diatto system we may refer readers to the ELECTRICAL REVIEW for November 1st, 1895, p. 535.

On the surface of the road, between the rails, are placed surface contact blocks at short intervals apart, each having in its centre a metallic piece, E, figs. 1 and 2, which is slightly raised above the surface. In the interior of the block is a pipe connected with the branch, I, from the cable, J, coming from the power house. The car carries an electro-magnet, A, which magnetises the pieces B, C, and D. These in gliding over the metallic surface piece attract a movable piece in the interior of the pipe which establishes electrical communication between the bar, B, on the car and the cable, J, from the station. The blocks are thus put in electrical connection with the cable only at the moment that the magnet bar of the car is above them, and the circuit is broken as soon as the car has passed. The blocks are placed sufficiently close together so that the magnet bar is always

Everett and Peake's paper of December 30th, 1898, contains several examples of this of very great interest, and others are more dense near B, which is the character of the actual field of a dynamo.



over one of them and the electrical connection between the cable and the car remains continuous. The contact block forming part of the pavement is made of asphalt, as shown in the transparent design, fig. 2, the middle of it being hollow and the opening to the surface containing a tube. At the upper part is a fixed plug, E, of anti-magnetic metal having at its centre a cylinder of soft iron, L. A little below this is a pair of iron brackets, G, H, embedded in the block, which support on their ends an ebonite cup filled with mercury. In the bottom of this cup is screwed a copper plug carrying a small copper rod, which is immersed at its lower end in another small cup of mercury. The latter is connected through the cable, I, to the cable, J, from the station. In the mercury which fills the ebonite cup floats an iron plunger, P, the weight of which is properly adjusted. The head of the plunger is formed of a truncated cone of homogeneous and very hard graphite, and the axis of the iron, L, also carries a piece of the same kind of carbon, which is hollowed out to perfectly fit the cone on the plunger. These two pieces of carbon join accurately and make an excellent electrical contact. The place where this contact is made is enclosed, as shown in the illustration, in a special chamber.

The magnet bars, B, C, D, are connected by horizontal electro-magnets, A, which make the central bar, B, a north pole, and the bars, C and D, south poles. The magnetic circuit is thus established from the bar, B, through the plunger, P, and the bracket, G, to the bar, C, and a similar circuit is established on the other side of the bar D. The magnetism draws the plunger, P, to its upper position. Each electro-magnet carries two windings, one of which is traversed by the current which operates the motors, and the other by a current from a small storage battery giving 5 amperes at 30 volts. At the moment of starting it is the current from this battery which energises the magnets and raises the plunger. Arcing is avoided when the current is broken at the carbon contacts by reason of the good quality of the carbons, and the rear end of the electro-magnet bar is slightly raised in order to avoid a too sudden breaking at the contact. The blocks are set in the paving, so that no water can possibly penetrate beneath them. The return current is carried to the power house by the track rails, and it may be added that defective blocks can be removed and replaced within a few minutes.

## ELECTRIC TRAMWAY PLANT.

THERE are at the present moment between 40 and 50 electric tramways in this country either in operation, or nearing completion, and it is interesting to examine some of the features that characterise the various plant and machinery that is being used. Most of our readers are aware that one of the reasons urged in extenuation of the want of standard systems in electric lighting plant was the modest and tentative manner in which it was taken up both by local authorities and companies. In tramways, however, there could be little or no excuse for many of the errors that were committed in the design of electric lighting plant. It is pleasing, therefore, to note that small units are not being adopted in any of the tramway schemes that have been proposed. Obviously, the size of a unit depends in a great measure upon the extent of the tramway system, but even in tramways that are only two or three miles in extent, and where there is not likely to be any immediate extension, the engines used are not small, considering the size of the line. In few cases are engines being adopted of less H.P. than 250, while in some instances engines of 1,200 H.P., 600 H.P., and 300 H P. are being put down. Probably the size mostly affected is one of about 330 H.P. There is not, however, any striking predilection for one type of engine over another, and it is worth noting that 16 systems are employing high speed engines, 24 low speed, four moderate speed engines, and two are using turbines. The most striking fact in connection with the engines is that the low speed type practically represents American engines in this country, and although it is at the moment difficult to ascertain the exact horse-power represented in these different types, there is little doubt that the preponderance is distinctly on the side of the low speed engines.

On the question of boilers there is a fairly equal division between Lancashire and water-tube types. Including under Lancashire two or three marine and loco. types, the total number of systems employing this class of boiler is 25, and of those using water-tube boilers, 16. Here, again, such comparisons may be misleading, because no indication is given of the horse-power of each type, but it may be fairly assumed that the difference in the number of systems is a fair criterion of the difference in the horse-power.

Coming to consider the outside work of the tramway system, there is a considerable diversity of practice in the gauge of the rails. Fortunately, however, the majority of systems use one of two gauges, and it is clear that local conditions have been mainly the cause of this. The majority of tramway systems are laid down on the standard gauge of 4 feet 8½ inches, and the total number employing this is 21. Sixteen systems, however, employ a gauge of 3 feet 6 inches, but as we have suggested, the exigencies of streets and thoroughfares are mainly responsible for this. There is one system, however, which is credited with using a 4 feet 7¾ gauge, and on the face of it there seems to be no very obvious reason for this practice. Four systems employ a gauge of 4 feet, four systems use a 3 feet gauge, and there is an isolated example of a tramway which employs one of 5 feet 3 inches. One need hardly say that the latter is in Ireland, namely, in Dublin, and it need not surprise anyone to learn that in some parts of the Dublin system, when two cars are side by side, there is no room for the narrowest vehicle to pass them. Ireland, by this, preserves its character for originality, but we should hesitate to say that the present tramway authorities are responsible for it, for many will no doubt remember the extraordinary method that was adopted in levelling the roadway for the necessary tramway system, which took no account of the foot pavement, with the consequence that, in some parts, the road was made higher than the pavement, and in some cases lower.

Notwithstanding the many objections raised in various quarters against combined lighting and tramway work, this method is being greatly extended, and at the present moment, out of the 46 systems in operation, or under construction, 21 are using a combined system; or, in other words, the tramways are being supplied with electrical energy from works that were originally put down for lighting purposes.

It is natural that there should be a considerable diversity of practice in overhead work; but, generally speaking, side and centre poles are characteristic of English work. It is true that in many cases the span wire has been adopted, and in some towns one could not quarrel with its appearance, for it is certainly immeasurably superior to side poles with long bracket arms.

It may be a matter of surprise to find that of the 46 tramways in operation, or in process of completion, 24 are owned and controlled by local authorities, as against 22 owned by companies. Moreover, there can be no doubt of the magnitude of some of the systems that are being undertaken by municipalities, two of the most notable being in the Manchester district, where the Manchester Corporation is carrying out probably the largest system in the country, and the neighbouring borough of Salford is pledged to complete a system of 40 miles of single track.

## THE DETERMINATION OF THE JUMP IN GUNS.*

BY CAPT. JOHN P. WISSER, U.S.A.

THE electrical tuning fork has been applied to many experimental determinations, among the latest of which are those of Lieut. Dunn, Ordnance Department, U.S. Army (*Journal United States Artillery*, Vol. vii., pp. 29 and 213); Lieut. Squier, U.S. Army; Prof. Crehore, Dartmouth College, and quite recently, Profs. Cranz and Koch, Stuttgart, Germany.

The investigations of these gentlemen on the vibrations in the vertical plane of the barrel of a rifle held horizontally constitute a noteworthy addition to the general subject of ballistics.

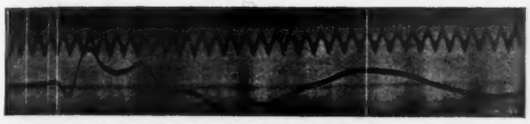
* New York *Electrical Review*.

due to one of these coils having a current $c$ is $l\,c$, it may be

sufficiently close together so that the magnet bar is alway



The Vertical Line $\gamma$ Marks the Instant the Projectile Leaves the Muzzle.



$\alpha\ \beta\gamma$

Fig. 1.—Curve of Vibration of a Point 1·5 Centimetres from Muzzle.

$\gamma$

Fig. 2.—Curve of Vibration of a Point 55·0 Centimetres from Muzzle.

$\gamma$

Fig. 3.—Curve of Vibration of a Point 110·5 Centimetres from Muzzle.

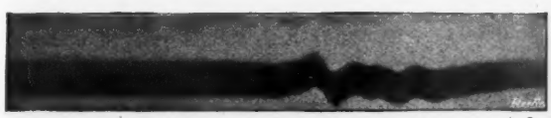
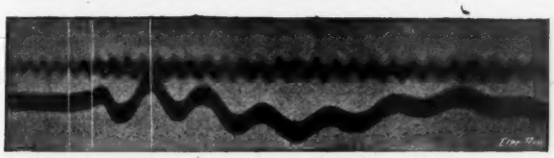
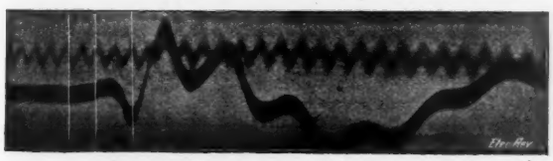


Fig. 4.—Curve of Vibration caused by merely pulling Trigger with no Charge in Rifle.



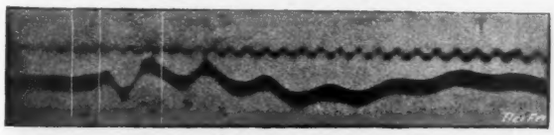
$\alpha\ \beta\quad\ \gamma$

Fig. 5.—Curve of Vibration of a Point 1·5 Centimetres from Muzzle with Half Charge.



$\alpha\ \beta\quad\ \gamma$

Fig. 6.—Curve of Vibration of a Point 1·5 Centimetres from Muzzle with Quarter Charge.



$\alpha\ \beta\quad\ \gamma$

Fig. 7.—Curve of Vibration 1·5 Centimetres from Muzzle with One-eighth Charge.

The cause of the so-called "jump" of rifles, that is, the angular difference (in a vertical plane) between the direction the projectile actually takes on leaving the muzzle of a gun and the direction it would have taken had it gone exactly as it was aimed, or, in technical language, the difference between the angle of elevation and the angle of projection, has long been veiled in mystery. The able investigators named above have undertaken the investigation of this subject, and have come to the conclusion that it is due to the vibrations set up in the gun barrel at the moment the gun is fired.

It will be remembered (see *Journal United States Artillery*, Vol. iv., No. 4, October, 1895) that Prof. Crehore and Lieut. Squier, in their investigations on a photographic method of determining the complete motion of a gun during recoil, came to the following conclusion: "It may be said, therefore, that a Springfield rifle does not move appreciably before the bullet leaves the muzzle. Even if the motion were appreciable, its direction is such that it is parallel to the axis, and does not affect the aim of the gun." Profs. Cranz and Koch came to a very different conclusion, and their data for this conclusion are presented graphically in the photographs reproduced herewith, of which the original article has many more.

Their method of procedure was similar to that of Profs. Crehore and Squier. To show graphically that there were vibrations, and to determine their character, they utilised instantaneous photography, a certain point of the barrel, during the movement of the projectile along the bore and after it left the bore, being photographed on a plate, which is moved rapidly past in the plane of the photograph. In this way the progress of the vibration of the point in question is photographed as a curve on the plate.

In order to determine the exact time for each position of the point, the vibration of a tuning fork (of known rate) is photographed on the plate at the same time, so that by counting the number of vibrations of the tuning fork (appearing as a waving line on the plate) the exact times in which the varying positions of the point occur may be readily determined.

The accompanying figures illustrate clearly how reliable and accurate their method was, and also how reasonable their conclusions. Fig. 1 shows above the vibrations of the tuning fork (the time scale for all the figures), and below the vibration curve of a point of the barrel 1·5 centimetres back from the muzzle, the vertical line $\gamma$ indicating the instant the projectile leaves the muzzle. Fig. 2 shows the motion of a point 55 centimetres back from the muzzle, and fig. 3 that of a point 110·5 centimetres back from the muzzle. Fig. 4 shows the vibrations of a point when the trigger is pulled without having any charge in the gun.

Fig. 5. shows the vibration of the same point as fig. 1, but with only half the full charge. Fig. 6 gives the same with only a quarter the charge, and fig. 7 the same with only one-eighth the charge. These figures explain how the jump varies with the charge, the number of vibrations being greater as the charge is less.

This constituted a splendid example of convincing investigation where actual observation of phenomena is impossible. The work of Profs. Cranz and Koch is a classic in its way, and makes a decided step forward in the solution of the intricate problem of the jump. Although their investigations so far have been confined to a particular small arm rifle, there is no reason why the conclusions reached should not apply to rifled guns of the largest calibre. The experimenters, however, are not content with this, but propose to continue their work, to determine, if possible, all the factors that enter and modify the jump in various pieces of ordnance.

## ELECTRICAL WORK IN 1899.

The year that has just closed has been a remarkably eventful one for most branches of the electrical industry. The manufacturers, to use a colloquialism, have been pulled out of the place. There has been a notable development in the use of electricity for lighting and motive power purposes, and, most important of all, there has been a conspicuous activity in the direction of electric tramways. There have been features which have not been especially agreeable, among which we may include the partial quashing of power trans-

mission schemes and the numerous interruptions in public lighting systems. Events which, if they had occurred singly, would probably have attracted great attention, have been crowded out of one's recollection by subsequent ones. Our esteemed contemporary, the *Engineer*, following an annual custom, has issued a review on the year's work, and has certainly given an entertaining, if not wholly accurate, account of what has happened. It is quite true, as our contemporary points out, that there has been a great difficulty on the part of contractors in supplying goods within the specified period, but though contractors may to some extent be blamable in the matter, we cannot wholly withhold blame from customers who, if they had conspired together to place contractors in a dilemma, could not have succeeded better than they have done. Though it may be departing somewhat from the subject, it is not uninteresting to mention that with the pressure still being maintained upon manufacturers they are not likely to improve very materially in their ability to deliver machinery, because there is little doubt that the war is calling off a large number of reservists, and though few of these may be skilled mechanics, many of them are filling positions of utility in workshops. In addition to this we opine that the difficulty of getting coal and the probable rise in price, mean not only delay but probably enhanced price of materials. It should not be forgotten, too, that the railway companies are impeding delivery of plant to a very considerable extent. Very properly our contemporary gives considerable prominence to the breakdowns that have been experienced in many supply systems; but the fact that many serious extinctions of light on the mains of the Westminster Company show the advisability of having two different sources of supply in the case of public buildings and large consumers of current, is hardly patent to everybody. One must sympathise with consumers of every class who are subject to interruptions of light; but the fact that there has been a temporary failure of electric light is not much of a reason why the consumer should have private plant. There are many public buildings using their own electric lighting plant, for the simple reason that it is cheaper than buying electricity from the street mains; but it would be quite contrary to the teachings of experience to put down one's own installation for emergency purposes. Under normal conditions a private plant is less reliable than a public service, and it is quite a common practice with persons who use their own plant to be connected to the public mains if a local supply exists. No one more than ourselves deplores the annoying cessations of supply which have been experienced in different parts of the country; but if reasonable precautions are taken to guard against breakdowns and interruptions electric lighting consumers need not be troubled. It is, we are sorry to say, the absence of precautions that has been responsible for many of the interruptions in electric lighting. We share the regret of our contemporary that there should be so much diversity of practice in the use of high voltage lamps, one town prefers 210, another 220, 230 and so on. The fault is entirely with the engineers of supply systems, and we should welcome any proposal that had for its object the standardising of engineers! Manufacturers of lamps say that the high voltage ones are as good as a 100-volt lamp, and quite recently a well-known municipal engineer came forward and corroborated this statement. The real judge of the matter is the consumer, and on this point it is difficult to obtain authentic information. We have previously expressed our opinion in these columns to the effect that more than one lighting authority has been somewhat arbitrary in dealing with the question of the change from 100 to 200-volt supply, and it is not surprising that consumers should have occasionally made protests. The question of 200-volt supply may now be considered closed, and if there are still difficulties in securing high voltage lamps, we are convinced that the matter will eventually right itself. An engineering survey of electrical progress could not have omitted some reference to the lines on which modern companies are developing; but though our contemporary notes the erection of *several* large stations at Willesden and elsewhere, it makes no note of the causes which have led up to these impending changes. As a matter of fact, there is only one station which is being built at Willesden for electric lighting purposes, and this is the polyphase station of the Metropolitan Electric Supply Company, the first portion of which is practically completed and is delivering current. It is quite true that the St. James's and Pall Mall Company contemplates the erection of large works at Willesden, and at some little distance away, the generating works of the Kensington and Notting Hill Companies are to be erected. The most interesting phase of the development is that companies which have been entirely identified with low pressure systems are compelled to go outside their own districts in order to erect plant large enough to cope with the probable demand. We suppose that is the ultimate destiny of most low pressure companies. They will continue, no doubt, to distribute continuous current to their customers, and there is every reason why they should; but primarily they will be compelled to generate high pressure currents outside their area of supply, and transmit to various centres where the necessary transformation will be effected. With the great expansion that is taking place among private electric lighting companies and the rapid development of municipalisation, there is likely to be a sharp conflict between the two great interests. We have already witnessed the repulse which the General Power Distributing Company met with in the House of Commons, mainly at the instance of the municipalities whose districts were threatened with competition; this was only a preliminary skirmish, and we are likely to see a further conflict between private enterprise and the advocates of municipalisation during the next Session of Parliament. It is not necessary to follow our contemporary through its references to the new works which have been opened during the past year, but it falls into some curious errors which we should hardly have expected to find in its pages. For instance, it is stated that at Bolton Ferranti fly-wheel dynamos have been installed to give 460 volts across the outer wires, on the three-wire system. Then, again, we are told that at Derby current is being supplied from the lighting station for traction purposes. Our contemporary notes with gratification the threatened activity of the London County Council in the domain of electric traction, and though we could have wished that the proposed tramway scheme were in the hands of a more stable body, it is something that there should be a proposal to start electric tramways on a large scale in the metropolis. At the same time we view with grave apprehension the suggested use of the conduit on a large scale, and it is to be sincerely hoped that further information will be eventually forthcoming on the financial experience of other countries in regard to conduits. The general progress that has been made in tramways is dealt with at some length, but apparently in our contemporary's estimation the most striking fact in connection with this is the use of combined stations for lighting and tramways. In many towns, combined stations have been more the result of accident than design, inasmuch as the stations have been in many cases designed for lighting, and it was only by a fortuitous circumstance that the municipality took up tramways.

It is only natural that electrical matters beyond our own shores should come in for some of the attention of our contemporary, and a rapid survey is made of developments in the United States, notably in transmission of electric energy over wide areas, and the adoption of electricity on steam railways. There is little doubt that the use of electricity on Chicago South Side Elevated Railway is one of the greatest accomplishments achieved by electrical engineers, and in face of the results that have been attained, it is difficult to account for the cramped and fitful experiments on the Metropolitan Railway. It has been pointed out more than once that since the adoption of the Sprague multiple unit system on the South Side Railway, the net earnings have been more than trebled by the alteration, and the ratio of expenses to earnings has decreased from over 80 per cent. to about 55 per cent. What are the directors of our underground railways doing to ignore such figures? Yet we suppose that if the experiments that are being made between Earl's Court and High Street, Kensington, are not successful, it will be concluded that there is no virtue in electric traction!

It is unfortunately true, as our contemporary suggests, that electric road carriages have made no brave show during 1899, yet accumulators are steadily improving all round.

Apparently the writer in the *Engineer* looks upon the Nernst lamp as a variety of ordinary incandescent lamp, for we are told that electric lamps of the ordinary carbon filament form do not appear to be so satisfactory when used with 200 volts pressure as they are when used with 100 volts, and Dr.

Nernst, of the University of Göttingen, has brought out a lamp which he states will give an efficiency of 1·5 watts per candle. No doubt this lamp possesses possibilities, and that is all that can be said for it as yet, although its advocates have faith in its ultimate success.

## CORRESPONDENCE.

### Tested Lamps.

With reference to the remarks made by "E. E. E." *re* flashing lamps, I would first point out that "F. P. S." has clearly stated that the filaments (as a rule) are not flashed in their bulbs, so it is quite unnecessary to discuss that point again, for if such were the case a considerable blackening of the bulb would take place, and this would render the lamp unsaleable.

With regard to the filling of the bulbs with gas before pumping, practised by some makers, this is done to make certain that the very small portion of gas left in the bulb is not air, or any gas injurious to the filament.

As to the increase of current mentioned, I have tested lamps of very nearly all makers (*English* and Continental), and I have found several in which the current was higher after 600 hours' burning than it was at the beginning.

I think the results of the *Tested Lamp Company* are more reliable, owing to the fact that they sell lamps, and that the information they give was acquired for their own guidance and interest, which latter is obviously to find the best lamp.

I also note that "E. E. E." is an Englishman, and that his patriotic feeling seems apt to run away with him. But, with due deference to him, I am of opinion that the average American lamp is considerably better than the average English one.

Lastly, I think that "E. E E.'s" case is a very feeble one, as he has unsuccessfully tried to pull to pieces a few isolated statements quoted from a thoroughly sound article.

**English Electric Engineer the Second.**

*January, 5th*, 1900.

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I must ask "Electric Engineer" to refer to my last letter, where he will find that I agree with him *re* the flashing of filaments.

Of course the "flashing gas" does not explode under the ordinary conditions of flashing, for if it did I do not see how any filaments could be flashed.

What I said was, "I know that at least one lampmaker puts gas into his bulbs." This I still maintain, and as I did not say what gas or for what purpose this was done, your correspondent has missed my point (namely, that gas *was* left in the bulbs), and has gone off at a tangent about the flashing and pumping processes. I cannot see how "Electric Engineer" makes out his second error, for on working out the figures (to which I believe he refers) I make the increase ·054 ampere, instead of ·0886 ampere, or his latter figure ·1134 ampere, which would be to the company's advantage. It seems a very difficult matter to write an answer clear enough to prevent your correspondent from evading it, but I must state that the current at the "end of a lamp's life" (of, say, 600 hours) is often greater than that at the commencement.

The above fact he would have seen if he had referred to Sir W. H. Preece's tests, as I asked him to do some weeks ago.

I hope that there will be no further need for me to trespass on your valuable space.

Surely Mr. Still does not mean to say that when an engineer orders 100-volt lamps he ought to test them at some other voltage?

I quite agree with him that it is sometimes diplomatic to supply a consumer with a lamp wrongly marked.

Mr. Still appears to think that the average starting efficiency of foreign lamps is 4½ watts per candle.

I can assure him that he is wrong, this is not the case.

If he wants to find a 4½-watt lamp I should advise him to look amongst some of the leading *English* makes before resorting to foreign ones.

**F. P. S.**
*Electrical Engineer.*

*January 6th*, 1900.

### The Use of Rubber Insulated Wire and Steel Conduits.

I have read with interest the article by Mr. Zingler on the above subject in your current issue. As one of the first, if not *the* first, to use metal tubing for the purpose of carrying electric light wires, it is gratifying to me that even at this late hour the question of metallic protection *v.* wood casing, is now receiving attention.

While agreeing with a number of points referred to in the article, there is one on which I strongly disagree. If it is a fact, as assumed, that rubber vulcanised cables have a limited life, I contend that this is all the more reason for protecting them with a metallic covering. Your contributor, on the contrary, considers that "as long as wood casing only is used, we see that no inconvenience is caused by the perishing of the India-rubber." In other words, he relies on the wood casing for his insulation. I think that this is a very dangerous argument. The insulating properties of wood remain good only so long as it is dry, and therefore, if from any cause there is an excess of moisture, a serious and dangerous leak must be set up at that point. With metallic tubing, on the other hand, should the insulation depreciate, causing a breakdown of the circuit, either the fuse goes, or the wire gives way inside the tube, which is incombustible, and no further damage is done. Personally, of course, I consider that the use of the metallic tube, with the outer earthed, ensures the greatest safety.

I also maintain that wires with metallic covering possess a much longer life than if covered by any organic material, such as wood, &c., which is liable to rot and decay. At all events, I can find no such depreciation in wires that have been laid in houses for the last 10 to 12 years, and which have been protected by metal tubing.

With regard to the use of substitutes, I think contractors will be very chary of adopting these in preference to rubber, as they are deficient in that flexibility which is such an important property in rubber, and in the wiring of a house it is practically impossible to avoid using bends.

I am glad to learn that a committee of the Institution of Electrical Engineers is at present engaged in drawing up rules and regulations on the subject of electric wiring. I hope the matter will be gone into thoroughly, as the question of the safest method of wiring is a most important one.

I do not think it is at all advisable to take an alarmist view of the situation, as the electric light, even with the methods of wiring in common use, is far safer than any other form of illumination; but, at the same time, cases of failure and damage have occurred, which are made the most of by the daily press, and I think, therefore, that every effort should be made to diminish the small risk due to the use of wood casing which at present exists.

**R. Frederick Yorke.**

Glasgow, *January 9th*, 1900.

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Mr. Zingler's article in current number of your paper is very amusing when read in connection with his remarks in some articles in the REVIEW about two years ago. Then it was only necessary to insulate the wire well and absolutely unnecessary to treat the tube. But what a climb down we now have. Even the insulating property of the nearly obsolete wood casing is supposed to have been the salvation of some jobs, and after a dissertation on joints, we are at last recommended to look out for a substitute for rubber. But while Mr. Zingler is gazing about in search of what appears to be very far off at present, others are working away with 300-megohm wire and insulated tube without any trouble due to moisture or cracked rubber, and without the use of such eminently unpractical devices as junction boxes with oil-tight glands round the wires. How would these glands and oil affect the wire in the pipe? I fail to see.

Why not accept at once the simple and reliable system of lined pipe, which will, after all is said and done, compare favourably even in price with any system such as that suggested above.

**W. H. Isherwood.**

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I would call your attention to the fact that Mr. Zingler seems to have considerably modified his views and opinions since dealing with the subject of "insulated pipe" for

interior wiring, in May, 1897, when one would have imagined from his article that plain iron pipe *was* the best system to use.

I have already expressed my personal opinion that there should be but little question as to the superiority of insulating lined pipe, but I am glad to find that my own experience is now evidently confirmed by this timely notice of Mr. Zingler in last week's REVIEW, and must thank him for bringing this important point up before any further issue of the I.E.E. rules is made.

Albert B. Butt.

## BUSINESS NOTICES, &c.

### Electrical Wares Exported.

| WEEK ENDING JAN. 10TH, 1899. | | WEEK ENDING JAN 9TH, 1900. | |
|---|---|---|---|
| Adelaide .. .. .. | Value £500 | Adelaide. Teleg. mat. .. | Value £75 |
| " Teleg. mat. .. .. | 907 | Alexandria .. .. .. | 27 |
| Buenos Ayres. Teleg. mat. .. | 750 | Amsterdam .. .. .. .. | 40 |
| Cape Town .. .. .. .. | 680 | Antwerp .. .. .. .. | 130 |
| Chinde .. .. .. .. | 75 | Beira. Teleg. mat. .. .. | 105 |
| Christiania .. .. .. .. | 110 | Bombay. Teleg. wire .. .. | 94 |
| Copenhagen .. .. .. | 50 | Boulogne .. .. .. .. | 41 |
| Durban .. .. .. .. | 20 | Brussels .. .. .. .. | 191 |
| " Teleg. mat. .. .. | 2,314 | Buenos Ayres .. .. .. | 543 |
| Fremantle .. .. .. .. | 65 | Calcutta .. .. .. .. | 86 |
| Gibraltar .. .. .. .. | 780 | Cape Town .. .. .. .. | 97 |
| Hamburg .. .. .. .. | 65 | Christiania .. .. .. .. | 22 |
| Lyttelton .. .. .. .. | 24 | " Teleg. mat. .. | 156 |
| Madras .. .. .. .. | 800 | Durban .. .. .. .. | 557 |
| Melbourne. Teleg. mat. .. | 470 | " Teleg. mat. .. .. | 926 |
| New York .. .. .. .. | 8 | " Teleg. mat. .. .. | 118 |
| Ostend. Electric light wires .. | 51 | East London .. .. .. | 180 |
| Perth .. .. .. .. .. | 26 | Fremantle .. .. .. .. | 7 |
| Stockholm .. .. .. .. | 30 | Gibraltar .. .. .. .. | 26 |
| " Teleg. mat. .. | 885 | Ghent .. .. .. .. | 56 |
| Sydney .. .. .. .. | 804 | Gothenburg .. .. .. .. | 20 |
| Yokohama .. .. .. .. | 473 | Hamburg. Teleg. mat. .. .. | 200 |
| | | Hong Kong .. .. .. | 85 |
| | | Jamaica .. .. .. .. | 13 |
| | | Melbourne .. .. .. .. | 188 |
| | | New York .. .. .. .. | 12 |
| | | " Teleg. apparatus .. | 809 |
| | | Osaka. Teleph. cable .. .. | 144 |
| | | Ostend .. .. .. .. | 53 |
| | | Otago. Teleg. wire .. .. | 1,357 |
| | | Perth .. .. .. .. .. | 225 |
| | | Port Amelia. Teleg. mat. .. | 1,155 |
| | | Reval .. .. .. .. | 45 |
| | | Rio Janeiro .. .. .. .. | 88 |
| | | " Teleg. mat. .. | 896 |
| | | Santos .. .. .. .. | 865 |
| | | " Teleg. mat. .. .. | 644 |
| | | St. Peterburg .. .. .. | 24 |
| | | " Teleg. paper .. | 243 |
| | | Shanghai .. .. .. .. | 84 |
| | | Singapore .. .. .. .. | 104 |
| | | " Teleg. mat. .. .. | 444 |
| | | Sydney .. .. .. .. | 88 |
| | | " Teleg. mat. .. .. | 1,058 |
| | | Wellington .. .. .. | 87 |
| | | " Telephones .. | 1,140 |
| Total .. | £8,397 | Total .. | £12,497 |

### Foreign Goods Transhipped.

| | |
|---|---|
| Buenos Ayres. Elec. lighting mat. .. .. .. | Value £620 |

**Advance in Rubber Goods.**—The India-Rubber, Gutta-Percha and Telegraph Works Company, Limited, announce that, in consequence of the continued increase in the cost of raw materials, they are reluctantly compelled to further advance the selling prices of India-rubber goods by 10 per cent. This advance takes effect from January 10th.

**Bankruptcy Proceedings.**—Notice of intended dividend is given in the case of Messrs. A. Blackburn & J. Walker (Blackburn, Walker & Co., electrical and mechanical engineers, of Dewsbury). January 24th is the last day for receiving proofs by the liquidator, T. Thomas, 4, Queen Street, Carmarthen.

Notice of a first and final dividend of 1s. 1d. is given in the *London Gazette* in the failure of W. A. Charles & J. S. Blackwell (Central Electrical and Engineering Company), payable on January 10th.

The public examination of H. L. Howard (Thompson, Howard & Co.), electrical and mechanical engineer, of York and Hull, took place last week. Debtor said he commenced business in York in Parliament Street.—The Official Receiver reported that the debtor and a partner named Thompson started in partnership in January, 1898, without capital, carrying on business as electrical engineers in York and Hull, and a window-cleaning business at Kingston-upon-Hull. Thompson died last June. The statement of affairs showed liabilities amounting to £1,998 10s. 5d. There was a deficiency of £1,307. In his deficiency account the debtor showed a loss on the business in Parliament Street of £200 in eight months, £170 lost in establishing a business in Hull, and £300 loss in Stonegate.—The Official Receiver pointed out that it was a serious case. The debtor had been in business since 1898, and there was all this deficiency. He wished to be better satisfied than he was that the money was gone.—The Registrar said the deficiency account must be properly made out. It must go on until it was properly explained.—The debtor attributed his insolvency to "business losses."—The case was adjourned, and an order was made for the giving of further details as to losses.

**Boiler Explosion.**—Five men were severely scalded by the bursting of a tube while working on a boiler in the electricity works, Deptford, on the 30th ult. All the men are progressing favourably towards recovery.

**Books Received.**—"Annual Report of the Commissioner of Patents for the Year 1898." Washington: Government Printing Office. 1899.

"Telephones and Microphones: How to Make and Use Them." Edited by Percival Marshall. London: Dawbarn & Ward, Limited. 6d. net.

"Lockwood's Builders' and Contractors' Price Book, 1900." Edited by F. T. W. Miller. London: Crosby Lockwood & Son. 4s.

"Lubrication and Lubricants." By Leonard Archbutt and R. Mountford Deeley. London: Chas. Griffin & Co., Limited. 21s.

**Catalogues, &c.**—The General Electric Company, Limited, have brought out an illustrated list, for insertion in section B of their catalogue, in which the new Short pattern of Solar enclosed arc lamps are described for working on circuits of voltages of 90 to 250, in series or parallel, and alternating or continuous, as may be required. The Long pattern Solar lamp and the Angold double carbon arc lamp (open type) are also described.

The British Westinghouse Company's Publishing Department sends us a copy of each of the following circulars describing its manufactures.— Circular No. 1,005 — Multipolar generators and motors, belted type for D.C. lighting and power; circular No. 1 006—Lightning arresters for A C. and D.C. circuits; circular No. 1,007—D.C. series arc lighting generator; circular No. 1,008—Belt driven single-phase alternators, 16,000 alternations per minute, 1,100 and 2,200 volts; circular No. 1,009—Belt driven polyphase alternators, 7,200 alternations per minute, 220, 440, 1,100, and 2,200 volts. Each of the circulars is fully and well illustrated.

The British Thomson-Houston Company, Limited, is circulating pamphlet No. 52 of its series. It contains illustrated notes of the B.T.H. direct current carbon feed enclosed arc lamps.

From the Cape Asbestos Company, Limited, of Minories, E C., we have received a desk blotting pad with calendar for 1900 on each sheet.

Messrs. Nicholson & de Winton, electrical and general engineers, of Victoria Street, S W., send us No. 1 of a series of lists of "Electrical Prices Current" which they are issuing for architects' use. Specification and prices of conductors appear in the present list:

**Charge of Stealing.**—At the Greenwich Police Court last week A. W. Longman, clerk, was charged with stealing £200 by falsifying the accounts of his employers, Messrs. Elliott Bros. The defalcations were stated to have extended over some years. A remand until Thursday was granted.

**Compulsory Purchase.**—At Guildhall, Westminster, before the Deputy High Bailiff of Westminster, Mr. John Troutbeck, and a special jury, proceedings were held on Tuesday to determine the sum to be awarded Messrs. Adams & Son, ironmongers, engineers, &c, and large contractors to the War Office and Admiralty, in respect of the compulsory acquisition of their business premises at 41 and 42, Marshall Street, and 12, 13, and 14, Marlborough Row, near Regent Street, by the St. James and Pall Mall Electric Lighting Company, who require the area for the extension of their works. The total of the claim was £10,200. On behalf of the company a valuation was put in totalling £2,300, to which was to be added, say, £1,000 for disturbance, and other sums for minor items, such as six months' rent of the temporary premises, the cost of removal, &c. Eventually the jury awarded the claimant £7,260.

**Duty on Imported Electricity.**—The *Financial News* publishes a telegram from Washington, to the effect that the officials of the Treasury Department are considering a proposition to levy a tariff duty on electric current generated in Canada and conducted across the border into the United States. The question was raised by the Niagara Falls Power Company, of Niagara Falls, N.Y., against the Ontario Power Company, the rival concern, situated across the river at Niagara Falls, Ont. The Ontario Power Company proposes to extend its lines to as many points as possible in the United States, selling its light and power to as many customers as it can get. This business, of course, competes seriously with that of the American company, and in a communication to the Treasury Department the officers of the latter company represent that inasmuch as the electric current is a thing of value bought and sold, and since, moreover, it comes in competition with an American industry, it should be made subject to duty. The Secretary of the Treasury has submitted the question to several leading collectors of customs in various ports, with a view to obtaining their opinions. The Ontario Power Company, in a communication to the Treasury Department, declares that the electric current cannot be regarded as an "article" within the meaning of the tariff law, despite the representation of the rival American company that electricity is a thing that can be measured as accurately as potatoes, or wheat, or cotton cloth.

**Electric Construction Company.**—A dinner was given on Saturday by Sir Daniel Cooper, Bart., G.C.M.G., to the staff and long-service employés of the Electric Construction Company, Limited. The hat was passed for their credit's sake to aid the Reservists' Fund, for which this company is doing well, having recently subscribed 100 guineas to the Lord Mayor's Fund, and in addition the workpeople are making a weekly collection until the war ceases.

**Explanation.**—The notice which appeared *re* Messrs. F. H. Royce & Co., Limited, in our issue of December 29th, under "Liquidations," is thought to require some explanation, and we are pleased to give it. Messrs. F. H. Royce went into liquidation purely for the purpose of reconstruction under the title of Royce, Limited, and a notice of the registration of this company appeared in the ELECTRICAL REVIEW, for October 27th, 1899. It is, of course, to be understood that it is the old company which is now in liquidation.

**Electricity at Broken Hill (Aus).**—A syndicate has come forward with a scheme for running electric or cable tramways at Broken Hill if the municipality will permit. The syndicate also suggests that it should be allowed to supply electricity to the municipality for lighting and other purposes.

**Facilities for British Inventors.**—It is stated in the *Times* that Mr. Ritchie, the President of the Board of Trade, has appointed a departmental committee upon the subject of patent facilities, and the following are the official terms of the reference, namely, "to consider various suggestions which have been made for developing the benefits afforded by the Patent Office to inventors, and report." The committee is to consist of Mr. F. J. S. Hopwood (chairman), Mr. Edward Carpmael, president of the Chartered Institute of Patent Agents, Mr. C. N. Dalton, C.B., Controller-General of Patents, Mr. J. A. Kempe, deputy-chairman of the Board of Customs, and Mr. S. E. Spring-Rice, C.B., of Her Majesty's Treasury. Mr. Arthur Neeves, of the Board of Trade, to be secretary of the committee.

**Light Railways.**—The Light Railway Commissioners have recommended the following orders to the Board of Trade for confirmation:—Rhyl and Prestatyn; Mid-Suffolk (from Haughley to Halesworth), with a branch to Debenham and Westerfield; Aldershot and Farnborough; East Anglian (Lowestoft to Kessingland).

**Liquidations, Dissolutions, &c.**—For the purposes of reconstruction it has been decided to wind up the Reason Manufacturing Company voluntarily, Mr. E. Wright, of 76, Cheapside, E.C., being appointed liquidator with authority to register a new company with the same name and to carry through certain agreements.

A meeting of the Manganese Bronze and Brass Company will be held at the offices of C. F. Kemp & Co., 71, Lombard Street, E.C., on February 15th, to hear an account of the winding up from the liquidator, Mr. E. J. Gardiner.

**Moving Coil Instruments.**—No one who has worked with both fixed-coil and moving-coil instruments can be in doubt as to which type is preferable; the perfect balance, dead-beat action, uniformity of scale division, absence of hysteresis errors, and the constancy of calibration, all combine to render the moving-coil instrument as near an approach to ideal perfection as could be wished for, whether it be reflecting galvanometer, or portable ammeter or voltmeter. The contrast between the behaviour of a good d'Arsonval, or still better, an Ayrton-Mather galvanometer, and that of a silk-suspension, magnetic control, needle galvanometer, is a revelation to those who try the former for the first time; the same is true of commercial ammeters and voltmeters, with the added recommendation of extremely small consumption of power in the moving-coil type. Our attention is drawn to this subject by the receipt of a handsome catalogue from Messrs. Evershed & Vignoles, Limited, in which a description is given of their latest and most improved moving-coil instruments, which are made with round or sector-shaped dials, of the edge-wise pattern, and in a portable form. The special features of the coil and its attachments are shown in the accompanying figure. It will be noticed that one end of the "former" on

which the coil is wound is of circular shape, and can pass through the air gaps of the magnetic circuit, so that the coil may be inserted or removed without disturbing the magnetic system in the least; the importance of this is due to the fact that the slightest change in the position of the magnetised parts leads to change in the magnetic field. Further, a hardened steel axle is employed, carrying a brass sleeve, to which the controlling spring, the leading-in strip, and the index, are fixed; the axle is ground to a needle point at both ends, and is carried in cups of hard sapphire, which, like the axle, can be renewed or repaired without interfering with the magnetic system. The projecting lever to which the controlling spring is attached, can be shifted to adjust the zero in case of a permanent alteration taking place. All the instruments are protected from external magnetic interference by means of magnetic shields, and the frame is insulated from the case, which can be earthed without risk. The value of the resistance in series with the moving coil in the voltmeters is independent of the temperature, and as it is very great compared with that of the coil there is practically no temperature error. A slight error due to this cause is practically unavoidable in the case of moving coil ammeters, but is minimised by the use of similar material for the ammeter shunts and by an unvarying resistance in series with the moving coil. In the catalogue before us particulars and prices are given of instruments of all sizes and ranges, with illustrations showing them singly and as erected on switchboards, while the list concludes with folding plates showing actual scales, full size, of the various types up to 15 inches radius. Other lists which we have received describe the Evershed volt and ampere gauges, calibrated on a new system, by which a sufficient degree of accuracy is ensured at a small cost; these are made in two qualities, with or without Evershed's dead-beat movement. Other lists give details of the familiar Evershed ammeters and voltmeters, of guaranteed accuracy, and of the latest pattern of portable testing set.

**South Wales Electric Power Scheme.**—With reference to the particulars already published regarding this scheme, we have now received from Messrs. Bramwell & Harris, the engineers to the Bill, a pamphlet containing a statement explaining the nature of the proposed undertaking for the information of local authorities, by means of extracts from the Bill and other notes. The promoters seek powers to set up three electrical generating stations, one at Neath, one at Pontypridd, and one at Pontypool. These sites are chosen for their suitability for the purpose, and from them the company propose to spread out an extensive system of electrical mains for the supply of electricity to anyone who wishes to use it, throughout the whole of the county of Glamorgan, and so much of Monmouthshire as lies to the west of the river Usk. The area of supply contains about 1,050 square miles, throughout which are scattered collieries, steel works, tinplate and copper works, stone quarries, railways, tramways, engineering and ship repairing works, and factories of all kinds. All these have need of power. The works and factories of South Wales are in competition with foreign manufacturers, and they are suffering, and may suffer still more in the future, for lack of those electrical facilities which their rivals enjoy.

Further, there are certain chemical and other industries for which South Wales possesses every other advantage, but which cannot be carried on for lack of cheap electrical facilities. At the present time only 16½ square miles, that is to say, one-sixtieth part of the above area, is supplied with electricity, whereas the new company desire to supply throughout the whole of the area. A further advantage to the public will be the facility for the running of electric tramways all over thickly populated districts. Many of the smaller towns or villages within the area would like to have this cheap and convenient mode of conveyance, but the capital cost of establishing them, as well as the uneconomical conditions involved by their irregular use—busy on market day and idle perhaps all the rest of the week—render it impossible for electric trams or light railways to be established in many districts under present conditions. It would be a very different thing, however, if all that the local authority had to do was to lay the rails in the streets, and to take power provided for them at a very low rate by the new company, and to be paid for by meter only as it is used. Electric lighting would also be available in villages, and in country houses, and also electricity for power. The feature of the company's system, which renders its facilities as cheaply, and readily available in the country as in the towns, will, it may be hoped, do a good deal in time to correct the denudation of the villages of population and capital, and the consequent overcrowding of the towns. The small employer in the country village, with his engineering shop or other small factory, will be able to obtain power from the company's mains at the same rate as in the towns, and will be able to produce nearly as cheaply as the large steam power works and mills. Farmers will use the company's power for many agricultural operations. The average price per Board of Trade unit at present ruling in South Wales is about 5d. The maximum which the new Company would be allowed to charge would be 4d. per unit for an intermittent supply, and 2d. per unit for a regular supply. It is probable that the actual charge would be much less. In distributing schemes in the manufacturing districts of America and the Continent, the current is supplied to large consumers for trade purposes at less than ½d. per unit, the average charge in a large number of such schemes being about ¼d. per unit. This means that works in these districts can obtain power on "tap" as they require it, or continuously, at the low price of about £4 to say £10 per H.P. per annum, a facility which gives them a great advantage over the British manufacturer, who has to provide his own power at a cost of from £15 to £30 per H.P. per annum.

The probable effect of the scheme upon municipal authorities (no competition), is considered, and an explanation is given showing how the company can produce so cheaply. It is stated that the principle of the Bill has been already approved by Parliament.

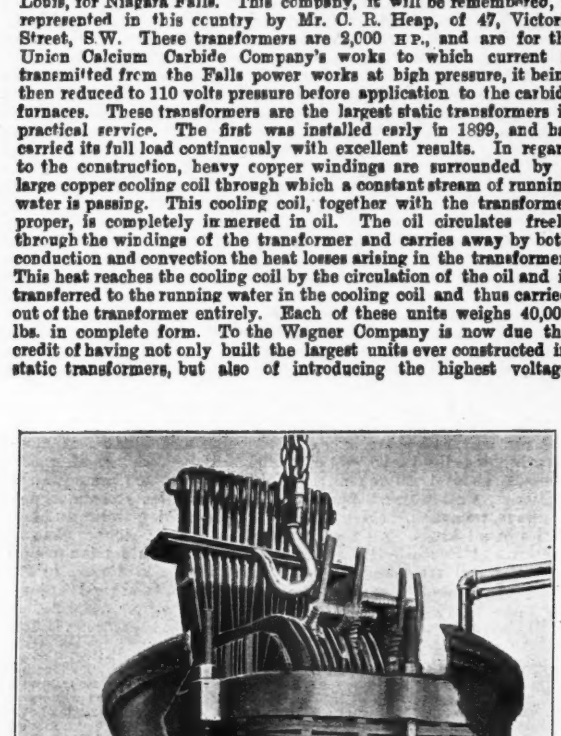
**Theatre Lighting.**—We have received the following from Messrs. Sax, Slatter & Co., with reference to an announcement made in our columns in December to the effect that that company had carried out the electric lighting installation and fittings at the Holloway Theatre of Varieties:—

This was a contract secured just before the Board decided to close our installation department, which was carried on at Basil Street, Sloane Street, and we did not carry on this work but sub-let it in its entirety. As a matter of fact, we are not doing installation work of any kind as, owing to the great increase in our supply business at Foresters' Hall, we give our sole attention to this department. We know that practically you are correct in saying we carried out the installation, as the contract was in our name, but with the foregoing explanation we feel sure you will put a small notice in your paper which may remove any impression that may have been created in the trade, to the effect, that we are not doing contract work.

**The Shannon Water-Power Scheme.**—The Limerick Fishery Conservators have resolved to oppose the Shannon Water and Electric Power Company's proposal to obtain Parliamentary sanction to utilise the water of Lough Derg.

**The Paris Exhibition.**—It is stated in the *Shipping World* that German firms will supply the electrical installations for light and power purposes all over the grounds of the forthcoming Paris Exhibition. Siemens & Halske and Schückert will each have a dynamo equal to about 2,000 H.P.; Helios, of Cologne, will have one of 1,900 H.P.; and Lahmeyer, of Frankfort-on-the-Maine, another of 1,400 H.P. The steam engines for these dynamos will be supplied by Herr Borsig, of Berlin, the Augsburg Company, and a Nuremburg company. The crane which is to be used for transporting heavy machines in the central gallery of the Avenue de Suffren will be supplied by Flohr, of Berlin. This crane will be capable of raising 25 tons to a height of 12·50 metres, and it will have a range of 26 metres.

**2,000 H.P. Wagner Transformers.**—We illustrate herewith one of seven large transformers which were recently supplied by the Wagner Electric Manufacturing Company, of St. Louis, for Niagara Falls. This company, it will be remembered, is represented in this country by Mr. C. R. Heap, of 47, Victoria Street, S.W. These transformers are 2,000 H.P., and are for the Union Calcium Carbide Company's works to which current is transmitted from the Falls power works at high pressure, it being then reduced to 110 volts pressure before application to the carbide furnaces. These transformers are the largest static transformers in practical service. The first was installed early in 1899, and has carried its full load continuously with excellent results. In regard to the construction, heavy copper windings are surrounded by a large copper cooling coil through which a constant stream of running water is passing. This cooling coil, together with the transformer proper, is completely immersed in oil. The oil circulates freely through the windings of the transformer and carries away by both conduction and convection the heat losses arising in the transformer. This heat reaches the cooling coil by the circulation of the oil and is transferred to the running water in the cooling coil and thus carried out of the transformer entirely. Each of these units weighs 40,000 lbs. in complete form. To the Wagner Company is now due the credit of having not only built the largest units ever constructed in static transformers, but also of introducing the highest voltage



transformers in large units that have ever been placed in practical service. The latter apparatus was installed on the circuits of the Telluride Power Transmission Company at Provo, Utah, and has been most successfully operated about two years on a line pressure of 40,000 volts. The units in this service are of 300 and less kilowatt capacity each. An immediate consequence of the success achieved in the equipment of the plant of the Union Carbide Company at Niagara Falls was the award to the Wagner Company of the contract for the similar equipment of the great Canadian Carbide Plant now building at Ottawa, Canada, in which will be installed, at the start, 20 units of 150 KW. output each.

**W. H. Allen, Son & Co.**—From particulars which have been placed before us it would seem that the year 1899 was an exceedingly busy one at the works of the above firm at Bedford. The outputs from the several departments are:—(1) Machinery for exclusive use on board ship; (2) for dock purposes in connection with the work in our ports; (3) for electric lighting power and tramways in towns; (4) for large irrigation and drainage schemes. When we say that no less than 75 of Her Majesty's warships have been supplied with machinery from Bedford, as well as about 40 torpedo destroyers, it will be seen that a large business is being done in this direction. At the close of 1898 the firm were finishing the auxiliary machinery on board H.M. cruisers *Diadem*, *Europa*, *Ariadne*, *Andromeda*, *Amphitrite*, and *Ocean*. During this year they supplied the whole of the dynamo-electrical machinery for H.M. cruisers *Cressy*, *Highflyer*, *Sutlej*, *Hogue*, *Aboukir*, *Euryalus*, *Bacchante*, *Pioneer*, *Hyacin*, *Hermes*, and *Vestal*, and are now constructing that for H.M. cruisers *Bedford*, *Drake*, *Hardinge*, *Essex*, *Kent*, and *Montague*, also for H.M. battleships *Russell* and *Bulwark*. They are also building pumping engines for the largest cruisers which have hitherto been constructed, of 30,000 I.H.P. each, including the *Drake*, *Good Hope*, *King Alfred*, and *Leviathan*. A recent addition to the manufactures of the firm is the construction of furnace air-blowing engines for delivering sprays of air over the flames of the furnaces in boilers of the Belleville type, and the following ships have been fitted with these machines:—H.M.S. *Hermes*, *Highflyer*, *Hyacinth*, *Sutlej*, *Bacchante*, *Drake*, *Monmouth*, and *Leviathan*. Another important section of the business is the installation of electric light and power on board steamers, the most notable which has been completed during this year being the great White Star Liner *Oceanic*, where close upon 2,000 lights were fitted, the current being provided by four sets of engines and dynamos of 500-I.H.P. In this boat the whole of the first-class cabins are heated, and a great deal of the culinary art and ventilating is carried out by electricity. The new fleet belonging to the White Star Line, 10 in all, has been entirely fitted up with electric light by the Bedford firm. The following list of boats have been equipped during the year:—*Sokoto*, *Guatemala*, *Colombia*, *St. Andrew*, *Montfort*, *Germanic*, *Bornu*, *Ismore*, *Cambroman*, *Kumara*, *Spiteful*, *Peteral*, *Rajah*, *Milwaukee*, *Medic*, *Montezuma*, *Winifredian*, *British Princess*, *Lake Erie*, *Ranee*, *Kygpo*, *Python*, *Darien*, *William Cliff*, *Dictator*, *Turcoman*, *Persic*, *Pinemore*, *Maplemore*, *Ortona*, *British Prince*, *Michigan*, and *Afric*, all belonging to the leading lines of steamers trading to all parts of the world, and varying in tonnage from 1,000 to 15,000 tons each. Many of the above names will be familiar to the public, appearing in the fleet now being used as transports for carrying our troops. Several hundreds of lights have had to be installed in each of these ships in a very short space of time in addition to their regular outfit. At the present moment Messrs. Allen have in hand one of the largest pumping engines which has ever been constructed, having branches no less than 54 inches in diameter, and driven by a triple expansion engine of the most modern type indicating from 800 to 1,000 H.P. To give some idea of the power of this one pumping engine, we may say that it is capable of delivering the equivalent of 4,000,000 gallons per hour. In regard to the electrical machinery for town lighting, during the year two large engines of 800 H.P. each have been erected, and are now in operation at Hull, and large plants for transmission of power have been completed at Belfast, Liverpool and Glasgow, that at Belfast being of 600 H.P. Three engines have also been supplied to the Belfast Corporation for electric lighting purposes in the harbour, while the new engine at the Woolwich Arsenal of 600 H.P. was also made at the Bedford works. The firm have now in hand the dynamo machinery for transmission of energy in connection with electric tramways and lighting for the towns of Bexhill, Reigate, Rotherham, Luton, Glasgow and Llandudno. They are also manufacturing a large plant for a similar purpose for some cotton factories in Lancashire, as well as for the foreign extensions of Messrs. Lever Bros., Sunlight Soap Works. A department has been created for supplying complete sets of condensing plants for electric lighting stations, which were originally proposed and designed by the firm, and some very interesting problems have been recently worked out, the chief being the substitution of electricity in the place of steam engines as in the past. This is done with a view to having only one set of engines for driving the main generators in all large lighting stations, while the whole of the auxiliary and smaller gear are driven entirely by electric motors. The following stations have been supplied with condensing plants on a large scale during the year:—Glasgow, Malta, West Ham, Bristol, Croydon and Rotterdam. The works are fully employed, sufficient orders being on the books to last some considerable time. To meet the constant increase, large extensions are now being added to the several buildings. A new pattern shop and brass foundry have been recently opened, while the work of doubling the size of the iron foundry will be shortly completed.

**The Copper Market in December.**—The copper market during December has been greatly disturbed, and the more weak-kneed holders of copper have been selling their warrants for forward delivery at prices considerably below those ruling a month ago. The price of G.M.B.'s, which on November 30th was £73 15s. per ton, has fallen to £70 at the close of the month, and sales of copper for delivery in February and March have been effected at £69. This fall has not been due to any striking alteration in the stocks of copper, or to any remarkable developments in mining activity, but appears to have been caused by simple nervousness on the part of speculators in copper, and to a general acceptance of the opinion that the era of high prices in the copper market is over, that the American Syndicate's control of supplies of copper has ceased to be effective. As regards supply and demand in December, Messrs. H. R. Merton and Co's monthly report shows that the total supplies were equal to 24,720 tons made up as follows:—North America, 14,000 tons; Spain and Portugal, 2,323 tons; Chili, 1,800 tons; Australia, 1,900 tons; "other" countries, 4,697 tons. All of these totals, with the exception of that for Chili, are above the average for the year 1899, the shipments from North America and from miscellaneous countries being notably so. The deliveries in December totalled 26,293 tons, and in addition to these 1,375 tons were shipped from English ports to America; the total deliveries therefore amounted to 27,668 tons. This is 2,948 tons in excess of the supplies, and a fall in stocks from 25,765 tons to 22,817 tons has consequently occurred during the past month.

**The Lancashire Electric Power Scheme.**—The Lancashire Electric Power Company, which has an important Bill in Parliament for the coming session, is likely to encounter formidable opposition from the local authorities. The promoters are Edmundson's Electricity Corporation, London, the Brush Electrical Engineering Company, Limited, London, and W. T. Glover & Co., Limited, Salford. Since the failure of the Bill last session upon a technical point the company have withdrawn the more objectionable clauses, asking for compulsory powers, and they have also eliminated Cheshire from the proposed area of supply. It is intended that the capital of three millions sterling, with ample borrowing powers, shall be devoted to the working of generating stations on the Lancashire coalfields, where the fuel can almost be pitched into the furnaces from the pit banks, and the distribution of the power over their area of supply. They contend that such convenient production, on an extensive scale, will enable them to effect great economies and take the new light and power to small districts which could never otherwise afford it. The extension of electricity as a motive power in mills and workshops is one direction in which the company look for revenue, and by cheapening the force they will help towards the realisation of their hopes. The Trafford Power and Light Supply Company, Limited, has shown what may be done by unrestricted enterprise. This company, which is in negotiation with the Stretford Council for the lighting of that district, is preparing to supply power to several large works on the Trafford estate. Buildings are erected, all the machinery is ready, and before the Lancashire Company's Act can come into operation the thing they wish to do will be in operation at Trafford Park. For power the maximum price to consumers in the bulk will be 1½d. per unit, with a reduction to ¼d. per unit on a maximum load of 1,200 hours per annum. For lighting the price will be 4d. per unit for a maximum load of 400 per annum, coming down to 2d. On the 23rd inst., at the Manchester Town Hall, there is to be a conference of municipal corporations and other local authorities affected by the company's Bill, with the view of creating an organised opposition.

**Trade Announcements.**—The Calmon Asbestos and Rubber Works, of Haydon Street, Minories, E.C., has now increased its share capital by £75,000, thus bringing the paid-up capital up to £225,000, with a view to creating the working capital necessary for a further extension of its business enterprises. The increased capital also serves to acquire another large, old-established and prosperous growing concern in the same line of business, which will further strengthen the already dominant position occupied by the company in the asbestos and rubber trades. The Deutsche Bank of Berlin is availing itself of the opportunity of the issue of the new share capital to introduce the stock of the Calmon Asbestos and Rubber Works, Limited, on the Berlin Stock Exchange. All the various departments of the works are said to be full up with remunerative orders.

Owing to increased business, Messrs. J. W. Manley & Co., Limited (successors to W. Taskar & Sons, Limited), electrical engineers, have removed to larger premises at 25, Victoria Street, S.W.

Mr. Frederick Grover, M.I.M.E., consulting engineer, has resigned his position at the Yorkshire College, Leeds, and his address is now Greek Street Chambers, Leeds.

Messrs. J. H. Winter & Co., electrical engineers and contractors, have removed to new premises at Narrow Wine Street, Bristol.

Messrs. White & Co., gas and electrical engineers, have now opened offices and showrooms at Blackfriars Road, Salford, where they will shortly have on view gas engines, shafting, pedestals, pulleys, &c., in motion.

## ELECTRIC LIGHTING NOTES.

**Accrington.**—A Blackburn paper says that it was stated at Accrington Town Council meeting on 7th inst., that a firm of electrical engineers had increased their tender by about £1,400, owing to the rise in the price of copper. If the Corporation had not deferred acceptance of the tender, it would have made a saving to that extent. The town clerk said the matter had been deferred owing to a difference of £200 with their expert. They had lost £1,400 through running after a ghost of £200.

**Alfreton.**—The ratepayers are being circularised by the District Council in order to ascertain whether popular opinion is in favour of establishing electricity works in the district. Mr. Barnes, electrical engineer, has furnished a report on the subject, in which the capital outlay is estimated at £11,500, and the annual working expenses at £1,202. The Lighting Committee is in favour of the scheme, and would adopt electricity for the street lighting if it were available.

**Auckland.**—An agreement with an electric lighting company to light the compulsory area within two years has been adopted. The company has already applied to the Board of Trade for the necessary powers.

**Bacup.**—The Bacup Corporation has decided to make application to the Local Government Board for sanction to borrow £22,400 for electric lighting purposes. It is proposed to use the present town's yard as the generating station, and the buildings are estimated to cost £5,400. Some time ago the Town Council decided to give to a private company the power to put down an electric plant for the town, but this resolution was rescinded at last week's meeting of the Council.

**Bangor.**—The Finance Committee of the City Council recommends that application be made to the Public Works Loans Board for a loan of £15,000 for the purposes of the electric lighting works.

**Berwick.**—Formal notice as to the proposed application on behalf of the Urban Electric Supply Company, Limited, for a provisional order to supply electric light to the town of Berwick-upon-Tweed having been laid before a Committee of the Town Council, it was agreed that there was nothing in the proposed application to which exception could be taken by the Town Council. The application will, therefore, be unopposed.

**Blackpool.**—The minutes of the Electric Lighting and Tramways Committee, which were adopted by the Council last week, recommended the borrowing of £6,000 for new tramcars, and also the acceptance of a number of tenders. In moving their adoption, Alderman Brodie said that the whole of the tenders, with the exception of those for offices, workrooms, and stores at the electricity works, were sanctioned two months ago, and the accepted tender was sanctioned some 12 months ago and had not been carried out up to now. The boilers, &c, under Messrs. Babcock & Wilcox's tender, were similar to the last one erected at the works. They were to be fitted with a class of stoker which the engineer had tested and found absolutely smokeless in its working. The final settlement as to supplying and fixing the switchboard had been referred to a sub-committee. With reference to the tender let to the British Insulated Wire Company for cables, &c., the Corporation dealt with them three years ago and obtained a 10 years' guarantee from them, and the same applied at the present time. Alderman Brodie briefly referred to the necessity for the transformers under the tender of the British Transformer Manufacturing Company, and as to the tender of the Hart Accumulator Company, they believed it was the best accumulator in the country at the present time. They were preparing so that in case anything should happen to the engine, they would be able to run from accumulators for a short time. They were also hoping to supply the printing works at night without running the machines. The tenders let would come up to some £30,000. The minutes were adopted.

**Blaenau Festiniog.**—The Urban District Council is in negotiation with the Electric Power Company with regard to the lighting of the streets with electricity. Several business premises and private residences are being supplied with electricity by the company. It is interesting to note that the generating plant was primarily intended for supplying power to the neighbouring quarries; the generating station of the company is situated at Dolwen, about two miles away from the town, and the power is supplied entirely by water taken from the Goedol river. The plant at present consists of two direct current dynamos, each capable of developing 100 H.P., coupled direct to a twin Pelton water-wheel. Arrangements are being made for doubling the plant at an early period. For lighting purposes a large storage battery is in course of erection at the generating station.

**Cardiff.**—The promised investigation into the cause of the recent failures of the electricity supply has not yet been carried out; we are pleased to note, however, in a local paper, that Mr. Applebee is now in supreme command of the electricity department, with full power to appoint and discharge the members of the various staffs. This is as it should be.

**Carlisle.**—The Town Council has resolved to abolish electricity meter rents, at the cost of a loss of revenue of £80 a year.

**Chesterfield.**—The Electrical Energy Committee of the Town Council has been instructed to consider and report upon the desirability of using gas engines for the purposes of the generating station to be provided for the borough.

**Dundalk.**—Steps are about to be taken by the District Council to carry into effect the electric lighting and tramway scheme. The project includes not only the electric lighting of the town—under powers obtained by the municipal authorities and transferred to the tramway company—but also an electric tramline through the town and out to the popular seaside resort, Blackrock. All preliminaries having been arranged, nothing remains but to execute the deed of transfer. It is expected that work will be commenced at once.

**Farnworth.**—The Farnworth District Council resolved at its meeting last Friday evening to apply to the Local Board for sanction to borrow £22,000 for putting down electrical works and plant, the estimate being made up as follows:—Buildings, £2,700; boilers, &c., £3,900; dynamos, boosters and balancers, and transformers, £5,220; switchboards and instruments, £840; accumulators and connections, £1,100; cables, £6,000; overhead crane, £240; contingencies, fees, and legal expenses, £2,000.

**Felling.**—The District Council on Monday last resolved that a petition be lodged against the Tyneside Electric Power Act, promoted by the Durham Electric Supply Company, Limited, in the Parliamentary session, 1900; also that the Council take steps to obtain a provisional order to supply electrical energy within the urban district of Felling.

**Germany.**—Messrs. Schuckert & Co., of Nuremberg, have secured a contract for the establishment and equipment of a municipal central station in the town of Erfurt, at an estimated cost of £60,000.

**Govan.**—The installation of street electric lighting is to be officially inaugurated on Saturday, 20th inst.

**Gloucester.**—At a special meeting of the City Council on Tuesday, the minutes of the Electricity Supply Committee, which were confirmed, stated that Mr. Hammond had prepared an analysis of the 28 tenders received and a report thereon, dealing separately with the tenders sent in for each of the four sections:—For Section A (boiler house plant), including one Lancashire boiler with mechanical stokers and other fittings, &c., eight tenders were received, ranging from £940 to £1,256. It was recommended that the tender of Messrs. Tinkers, Limited, amounting to £955 be accepted. For Section B (engine house plant), including one 300-KW. steam dynamo and pipe work, 15 tenders were received, ranging from £3,140 to £5,002. It was recommended that the tender of Messrs. Mather and Platt, Limited, amounting to £3,988, be accepted. For Section C (extension of switchboard), four tenders were received, ranging from £210 to £280. It was recommended that the tender of Messrs. Crompton & Co., Limited (the makers of the main switchboard), amounting to £251, be accepted. For Section D (condensing plant), eight tenders were received, ranging from £493 to £759. It was recommended that the tender of Messrs. E. Chester & Co., Limited, amounting to £493 (the lowest tender), be accepted.

Mr. Hammond submitted a statement showing the amount of loan sanctioned by the Local Government Board for the electricity works, and the expenditure and commitments in respect thereof, from which it appeared that the works included in the estimate would be carried out at about the estimated cost. The statement also gave particulars of the estimated cost of the proposed additional plant required for the electricity works, including additional mains, arc lamps, meters, demand indicators and incidentals; and also an estimate for the expenditure in respect of the refuse destructor, including the incidental buildings, high level road, steam boiler and pipe work, mortar mill, &c., showing that the further amount required would be as follows:—Electricity works, £9,425; refuse destructor, £8,575; total, £18,000. It was resolved that the Council be recommended to apply to the Local Government Board for sanction to borrow the further sum of £9,425 for the electricity works and £8,575 for the refuse destructor.

In presenting the minutes for confirmation, Mr. C. H. Clutterbuck (chairman of the Electrical Committee) said that already the applications for the light had been so numerous that the Committee felt justified in asking for this additional loan. If they delayed to do so they would only inconvenience those who were anxious to have the light. He believed that no town had ever started a scheme with so many customers, excepting Plymouth. This showed how heartily the citizens of Gloucester were taking up the light. The applications to date were as follows:—Supply available for private lighting, 12,000 8-C.P. lamps; total of present applications 9,771; required for municipal buildings (say), 2,000, equals 11,771, leaving a total available for private lighting, 229.

**Grantham.**—The Electric Lighting Committee last week recommended the Town Council to consent to the application for a provisional order submitted to the Board of Trade by the Urban Electric Supply Company, Limited, provided the company entered into an agreement with the Council, by which it will not be allowed to make a charge exceeding:—For street lighting or other public purposes 7d. per unit for the first hour, 2d. per unit after the first hour; for motive power 4d. per unit for the first hour, and 1d. per unit afterwards. The report was adopted by the Council.

**Hackney.**—Last week a special meeting of the Vestry was held to open tenders for accumulators for the municipal electricity works. The tenders were from the Electrical Power Storage Company, Limited, the Chloride Electrical Storage Syndicate, the Hart Accumulator Company, the D.P. Battery Company, and the Tudor Accumulator Company. These were referred to the Electric Lighting Committee.

**Halifax.**—In its Omnibus Bill the Corporation seeks borrowing powers for £326,800 for tramway purposes and £100,000 for the purposes of the electric lighting undertaking.

**Ilfracombe.**—Messrs. Ffinch & Chanter lately wrote on behalf of the directors of the Ilfracombe Gas Company, submitting terms for carrying out the electric lighting of the town, and taking over the provisional order obtained by the District Council. The Edmundson's Electricity Company also sent terms for the work. The matter was adjourned *sine die*. Has the dog-in-the-manger policy been adopted? We trust that the Council will carry out the work on its own behalf, rather than block the way.

**Inverness.**—As the result of an explosion in the acetylene factory of the British Aluminium Company at Foyers, 12 men were injured, two of them seriously. They are said to be progressing favourably.

**Kingston.**—At a meeting of the Kingston Town Council last Tuesday, Alderman Collings, chairman of the Lighting Committee, speaking of the electric lamps in the streets of the borough not being lighted a few nights ago, stated that it was in consequence of the Government laying hands on all the coal that could be procured. As a result, the Corporation were unable to get sufficient coal to maintain the whole of their electric lighting plant.

**Leyton.**—The Urban District Council recently resolved that application be made to the Local Government Board for a floating loan of £5,000, to enable it to meet requirements for the extension of mains, &c. This was done to avoid the delay consequent on a formal application.

**Hastings.**—The Town Council has resolved to purchase a new engine and alternator for the electricity works, at a cost of £1,385 and £1,455 respectively.

**Leigh.**—The electricity supply was switched on for the first time on Tuesday last week. The installation has cost over £10,000, and is on the three-wire system, at a pressure of 440 volts. At present only the compulsory area is lit, but extensions are already projected. The charges are 7d. per unit for the first hour, and 2½d. per unit afterwards. A committee of the Town Council has also under consideration the question of electric traction.

**Liverpool.**—At a recent meeting of the Electric Lighting Committee of the Liverpool City Council, it was resolved that three men employed at the electricity works, who had been called up as Reservists to rejoin their regiments, should be reinstated on their return.

**London.**—According to the *Financial Times*, the secretary of the Marylebone Electric Supply Company, an undertaking promoted by the St. James's and Pall Mall Electric Lighting Company, has just addressed a long letter to the Vestry of St. Marylebone, informing that authority that the company is applying to the Board of Trade for a provisional order to supply electricity in Marylebone, in accordance with the formal notice given by its solicitors on July 1st last. The letter points out that the company has approached the Vestry with a similar object for the past two years, and has on each occasion withdrawn on failing to obtain the consent of the Vestry. There is no wish on the part of the company to pursue the matter further if the Vestry is in a position to take up the work, but as, in the opinion of the directors, this has become impossible, except by the purchase of the interests of the existing company (the Metropolitan Electric Supply Company), they have decided to make a third application, and to ask for the support of the Vestry. As soon as the provisional order has been obtained, the company proposes to lay down a network of mains over the whole parish, and to give a supply of the electric light from two stations in the district on the same system which has been brought to such a successful issue in the neighbouring parish of St. James's. The St. James's and Pall Mall Company, which supplies the St. James's district, is under the direction of the same people, who are supporting the application, and has reduced its charges to a sliding scale of from 6d. to 4d. for lighting purposes, and at the commencement of 1899 made a special discount of 8 per cent. to all consumers for prompt payment, thus reducing the maximum charge to 5½d. per unit. That company's two stations, standing on freehold property, have been constructed at a cost which will compare most favourably with that of the other London undertakings. The same course will be adopted with the Marylebone Electric Supply Company, and it is expected that still more favourable results will be obtained; in other words, Marylebone will be equipped with a complete electric lighting service with modern plant at a cost considerably lower than that of any existing undertaking. The letter states further that, at the expiration of 42 years, the Vestry may acquire the undertaking under the usual purchase clause, and in the ultimate purchase there will be no pioneer or experimental work to be paid for. It is intended to confine the company's operations entirely to Marylebone, and it will not associate itself with any competing company for the purpose of keeping up rates and destroying competition. The letter, after pointing out advantages which the company says will accrue to the district by the Vestry consenting to the application, and stating that the low pressure continuous current system will be adopted, concludes by asking the Vestry to receive representatives of the company in order to discuss the question. The above letter, the full text of which was placed before the Marylebone Vestry at the meeting on Thursday last week, led to a long and animated discussion.—Mr. Edward White, L.C.C., proposed that the company should be informed that the Vestry objected to the application to the Board of Trade for a provisional order.—Mr. John Lewis seconded the motion, which was eventually adopted.

The President of the Board of Trade has consented to receive, on the 17th inst., a deputation of those who have suffered from the alleged failures of the Metropolitan Electrical Supply Company to supply them with electricity.

The Vestry of St. George the Martyr is discontented with the electricity supply provided by the London Electrical Supply Corporation, Limited, and has resolved to ask the London County Council to take legal proceedings in the matter.

**Manchester.**—On Friday the 5th inst., about 2 p.m., some workmen in Princess Street employed by the waterworks department drove a steel crowbar into a culvert, causing a short circuit which was quickly cleared. Within a few minutes of this short circuit, however, another one occurred, apparently in consequence of it, in a different part of the town, namely, in Bank Street, near the Royal Exchange, on five ⅛-square-inch rubber cables in a pipe. The heat of the short circuit distilled the rubber and tarry compound in the braiding surrounding the conductors, thus forming an explosive mixture, which passed into a junction box and culvert, and becoming ignited, exploded. The lid of the junction box was blown off, and the flagstones immediately over the culvert were disturbed for a few yards. No person was hurt, nor was any damage done to property beyond the breaking of one pane of glass. The supply was not interrupted, the pressure being merely unsteady for a few minutes. The consumers on the actual length of main affected, about 40 yards, were without light until the following day, while in consequence of the short circuit a few consumers were without light for about an hour, namely, those connected to the length of main, about 200 yards, affected by the crowbar.

**Melbourne.**—Mr. A. J. Arnot, the city electrical engineer of Melbourne, has been making a six months' tour in America, England, and the Continent inspecting the best electrical systems, so that the good points may be taken advantage of in putting down the Melbourne new system. He has undergone the usual interview, the *Municipal Journal* having inquired his views regarding English installations. He has visited about a dozen of the more important, and when asked what he thinks of them is made to say that "they are gradually getting up to date," but are by no means in first-class order yet, they having been very much handicapped by the rush of customers and by makeshift appliances. "One of the greatest difficulties they have had to encounter has been the getting of plant, but, of course, that is only a matter of time." The new installation for Melbourne is to cost about £120,000.

**Northampton.**—The Town Council has granted permission to the Northampton Electric Light and Power Company to alter the standard pressure in their distributing mains and at the consumers' terminals from 105 to 210 volts.

**Oldham.**—At the Town Hall, Oldham, on Tuesday, Mr. H. Percy Boulnois, an inspector of the Local Government Board, held an inquiry with reference to an application of the Corporation for leave to borrow £36,000 for the purpose of meeting the cost of extensive additions to the electric station, the erection of a new boiler house, and other additions to the works. The town clerk stated that the results of the Oldham electricity undertaking had been most satisfactory, and when this money it was now sought to borrow was expended on the existing depôt and works, the site would be completely filled up. Since March 25th last, there had been an increase of 3,000 lamps, and they had had a considerable number of applications for electric current, which would have to wait until they obtained more power. Last year the Corporation obtained an Act of Parliament to lay down 25 miles of tramway lines to be worked by electricity, and there were already existing about 25 miles. The town clerk stated that the gross revenue in 1895 was £1,915 16s. 4d. and expenditure £1,271 18s. 3d., whilst the revenue on March 25th, 1899, was £6,804 2s. 6d. and the expenditure £3,243 5s. 9d., the net profit for the latter year being £884 12s. 6d. The total capital expenditure was £57,109 17s. 1d. Mr. S. Wall objected to the principle of spending the money before the inquiry had been held. £7,000 had already been spent without the sanction of the Local Government Board, and the inspector had not been told the amount of the contract for which the Corporation was already liable. The inspector said he would have to report the fact that work had been proceeded with, and he did not know what reply the Local Government Board would make.

**Plymouth.**—So great has been the demand for the electric light in Plymouth, that although the works were only opened in September last, their capacity is already tried to the utmost. The plant is adapted to the supply of 7,500 8-C.P. lamps, in addition to the public arc lighting and the tramway service. Orders have been accepted for connections equal to 12,200 8 C.P. lamps, and other applicants have been informed that they must wait until the works are extended. On the recommendation of the borough electrical engineer (Mr. J. H. Rider) the Electricity Committee has decided to apply for a further loan of £48,000, which will be in addition to the loan already applied for, for the extension of the electric tramways. Of the £48,000 the sum of £10,720 is to cover the amount spent in excess of the original sanction. The new works recommended include an extension of the buildings, estimated to cost £12,500, and the necessary plant for an additional 500-KW. output, as well as extension of the cables in several parts of the town for which applications are coming in. The proposed extension of the buildings by about 90 feet will make engine and boiler rooms 190 feet long, and will allow of the addition of four more 700-H.P. sets when necessary. The works are to be proceeded with at once, in the hope that they may be ready to meet next winter's demands.

**Sleaford.**—At a meeting of the Sleaford Urban District Council last week, a scheme for lighting the town by electricity was adopted.

**Smethwick.**—A conference took place last week between representatives of the Midland Electrical Corporation and a Committee of the Smethwick Town Council. The latter is determined to retain the right to supply electricity in its own district, but will probably purchase electricity in bulk from the company, at least for a time, if terms can be agreed upon.

**South Shields.**—The Town Council last week had under consideration notices of application to Parliament by the Tyneside Electric Power Company for power to supply electricity in certain boroughs and districts on Tyneside, and by the County of Durham Electric Power Supply Company for power to supply electricity in bulk to any lighting authority, or to any company or person authorised by Act of Parliament, license, or order, to supply or to use electricity within the districts of the Poor Law Union of Gateshead, South Shields, Sunderland, &c. It was resolved that the town clerk write to all the local authorities concerned, and suggest that a meeting be held for the purpose of deciding upon a joint course of action. The report of the electrical engineer, Mr. Jeckell, states that for the week ending December 2nd, 1899, there were 20,003 units consumed, as compared with 13,085 in the corresponding week in 1898, or rather more than 50 per cent. increase. The maximum load reached was attained on December 30th, when they had 232 amperes, which involved the running of three engines. The maximum output upon any given day was reached on December 23rd, when 4,058 units were sold. The preceding maximum was in December, 1898, when 2,500 units were sold. The units sold for the last quarter were 129,000, as against 79,000 for the quarter ending 1898. The chief clerk in the office (Mr. J. C. Peterson) was called up by the Northumberland Hussars, and would leave his situation.

**Sydney (N.S.W.).**—With reference to the appointment of Major Cardew to report to the Council *re* electricity supply, the following are the recommendations of the Electric Lighting Committee on the matter as adopted:—

1. That the firm of Preece & Cardew be employed to report on and prepare a scheme for lighting the city of Sydney by electricity. 2. That Major Cardew visit Sydney to prepare and submit a scheme at a cost to the Corporation of 1,000 guineas, whether the scheme be adopted or not; this sum to include all travelling expenses. If his stay in Sydney be prolonged beyond six weeks, an additional fee of five guineas per day to be paid by the Corporation. 3. That if the scheme be adopted, a commission of 2½ per cent. on the capital expenditure be paid for the preparation of plans and specifications, advising on tenders, and inspecting plant previous to shipment to Sydney; but exclusive of all expenses of inspecting plant out of the United Kingdom. 4. That the Council appoint a resident engineer, nominated by Messrs. Preece & Cardew, to supervise the erection of the plant in Sydney, the salary for such engineer not to exceed £600 per annum.

**Walsall.**—The question of extending the site for electricity works is being considered.

**Wigan.**—On Thursday last week the Mayor of Wigan (Mr. J. T. Gee) laid the foundation stone of the new power station in connection with the electrical undertaking of the Wigan Corporation. The proposals of the Corporation involve the expenditure of £85,000 for the purposes of electric lighting, and £40,000 on two lines of tramways, whilst the probable expenditure in the future will include the working by electric traction of the whole of the Wigan and district tramways, making a total capital outlay of between £300,000 and £400,000. Mr. H. Collings Bishop is the electrical engineer.

At a meeting of the Electric Lighting Committee of the Wigan Corporation yesterday week, Mr. J. W. Hame, of Cork, was appointed to the position of assistant electrical engineer for the borough. Mr. G. F. Kenyon, of Charlton, was next on the list of selected candidates.

**Worthing.**—The Electric Lighting Committee of the Town Council having reported the receipt from the Local Government Board of permission to borrow the sum of £32,500 for electric lighting purposes, the Council has agreed to instruct Messrs Burstall and Monkhouse to prepare the necessary plans and specifications in order that tenders may be invited for the execution of the work.

**Wrexham.**—At a special meeting of the Town Council last week, the following tenders were accepted, on the recommendation of a committee:—Boilers, Messrs. Babcock & Wilcox, £2,527; steam dynamos, &c., the Lancashire Dynamo and Motor Company, £7,286 10s.; switchboards, Messrs. Brook, Hirst & Co., Chester, £589; underground mains, arc lamps, standards, &c, the St. Helens Cable Company, £4,499 11s. 7d.; accumulators, the Chloride Battery Company, £991; travelling crane, Messrs. Carrick & Ritchie, £140. It was decided to advertise afresh for tenders for a destructor. The engineers estimate the total cost of the undertaking at £21,722 9s. 7d.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Airdrie and Coatbridge.**—A deputation from the Airdrie Town Council has been in London and has arranged with the manager of the New General Traction Company, Limited, who are promoting a Bill for a tramway through Airdrie and Coatbridge, to get all the provisions desired by the Town Council in return for their support. Coatbridge Council has not been represented, but the company has offered to pay the expenses of the abandoned Corporations' Bill if Coatbridge also supports this, the only Bill now before Parliament.

**Bristol.**—At the last meeting of the Sanitary Committee the city engineer presented a further report on the application from the Tramways Company to lay a double line of rails over Lawrence Hill bridge when it is widened. The committee had consented, subject to certain conditions, the principal of which was that the company should pave with hard wood the entire width of the carriage way. In reply the company stated they could only pave the tramway area, which, with a double line, would cover 19 feet. Upon this, the city engineer further reported that the Corporation could replace the granite setts with wood paving at a cost of £3,542, whilst the cost of laying hard wood between the tramway margins and the kerb would be £1,913. Several members expressed the opinion that the Tramways Company ought to be prepared to pave the whole roadway with wood if permitted to double their line. The engineer was instructed to continue negotiations.

**Damages.**—At the Stoke-on-Trent County Court on Monday, James Walters, grocer and confectioner, Fenton, sued the Potteries Electric Traction Company for £8 15s. 6d. damages, arising from a collision between the plaintiff's bread cart and one of the company's electric tramcars, such collision being caused by the alleged negligence of one of the company's servants. His Honour gave judgment for the plaintiff for the amount claimed, with costs.

**Isle of Man.**—A Liverpool paper says that in the near future the electric trams running between Derby Castle and Ramsey will be worked by turbine power. The experiment was tried on Tuesday last week, and proved a great success. Large turbines have been constructed at Laxey, and these generate sufficient power to supply the whole system. It is calculated that this will mean a big saving to the company.

**Bath.**—The Light Railway Commissioners opened two inquiries at the Guildhall on 8th inst., concerning the applications which have been made to them for an order to supply Bath and its district with electric tramways. One was promoted by a London syndicate and the other by the Corporation. Mr. Fitzgerald was in the chair, accompanied by Col. Boughie. Mr. Lewis Coward conducted the case for the Corporation. The syndicate had briefed Dr. Blake Odgers, Q.C. The application of the syndicate was first taken, and Dr. Blake Odgers mentioned that the promoters of this scheme for whom he appeared were Mr. J. W. Davies, Mr. H. T. Ellis, Mr. J. F. Hosken, Sir James Sivewright, K.C.B, Mr. Leopold Hirsch, and other financial gentlemen. Counsel proceeded to read the filed objections of the Corporation to the syndicate's application, which have already been published. Dealing with reference to the existing tramways and the contention that the electric tramways would depreciate the value of those now existing, which the Corporation propose to acquire in 1901, the Doctor said if that were so it would mean that the Corporation would have less to pay as purchase price; but the tramways company did not oppose, on the contrary, they were present in support of the promoters, and there would be no objection raised by them that day. He did not know what method the Corporation proposed to employ to run their trams by, but he should be surprised if their idea was to use the same overhead system, although that was what they objected to their (the promoters) using. It was contended by the Corporation that they had established an electric lighting station, and had the capacity to supply a day load for running trams. It was an open secret that the electric lighting by the Corporation had not so far paid its way, and it was apparently suggested that it should be made to do so by using the same power for running trams during the daytime, but he would point out that it was during the winter when the traffic would be most heavy (in the late afternoon and early evening) that most light was required.—Mr. E. B. Titley said he appeared for the Bath Road Car and Tramway Company, who were the proprietors of the existing tramways in Bath, and had to say that the promoters of this Bill had come to an equitable arrangement with the company he represented, and for that reason they did not oppose.—Mr. Walter Hopkins (of the firm of George Hopkins & Co., civil engineers, of London), engineer to the promoters, gave particulars of the scheme and the districts which it embraced. The length of tramways proposed was just under 18 miles, for over 10 miles of which double lines were intended. Seven miles would be outside the area of the city. The total cost of construction of their scheme was put at £222,000, which included electric equipment and power, the capital for which they had borrowing powers being £250,000. The Corporation put the sum required for their scheme at precisely the same amount. The Corporation announced its intention to drop certain of its proposed lines.

The chairman of the Commissioners announced that they were not convinced that there was at present any widespread desire, either in the city or in the adjacent districts, for an extension of the tramways system in the city, or from the city to the outside districts. Moreover, they thought that in such a case the Act pointed to a combined scheme between the several authorities interested, or else to leaving the matter in the hands of a company which would command the confidence of the authority. On the whole, they could not recommend the order to be given to the Bath Corporation. The decision, which involved the refusal of both applications, was received with much surprise.

**Glasgow.**—The Town Council is being asked to agree to an understanding come to with the engineers and boilermakers with regard to the height of trolley wires in Dumbarton Road, from Partick Cross to Finnieston, and in Govan Road, from Linthouse to Summertown Road. It is proposed that the overhead construction be so arranged that the span wires can be raised high enough to permit of boilers or large pieces of machinery passing along. The operation of raising the wires will be carried out after the traffic has ceased for the night.

The *Glasgow Herald* understands that the official report which Mr. John Young, the general manager of the Corporation tramways, has forwarded to the Board of Trade with reference to the fatal collision which occurred between electric cars in Springburn Road on Monday afternoon, states that the brake of the single-deck car which ran into the double-decker was tested immediately after the accident, and found to be in perfect order. It is, however, alleged that the driver of the single-deck car, John Macleod, was under the influence of drink at the time, and that he had not touched his brake when the accident occurred.

**Hammersmith.**—At the meeting of the Vestry last week a letter from the County Council was read, with a resolution passed by the Council, sanctioning the plans submitted by the London United Tramways Company for the overhead or trolley system of electrical traction on the company's lines in Uxbridge Road and Goldhawk Road. The sanction, however, was given without prejudice to any action which the Council might decide to take with regard to the proposal of the company for the amendment of their Act of last year relating to the equipment for an underground system of electrical traction on their lines between Young's Corner and the Broadway. The conditions accompanying the sanction are that the trolley wires be not attached to the electric lighting standards, that the company furnish the Vestry with detailed drawings of the inspection chambers and boxes to be placed in the carriageways or footways, &c., the "Bristol" designs for the side and centre traction poles be used, but the cut-out circuits be of such length as shall be approved by the Council's chief engineer. The matter was referred to the Electricity and Lighting Committee.

**Huddersfield.**—The Corporation Tramways Bill, to come before the next session of Parliament, seeks power to raise £261,203 for the construction of tramways and £139,147 for tramway purposes. The new tramways proposed are 15 in number, and range in length from 9·83 chains to 4 miles 2 furlongs. The total length of the new lines will be about 23 miles.

**Hyde.**—At Monday's meeting of the Town Council, the Electricity Committee reported that the town clerk had conferred with the town clerk of Dukinfield with reference to the opposition to be given to the new electric tramways scheme proposed by the Oldham, Ashton, and Hyde Electric Tramway Company. The town clerk was thereupon instructed to ascertain whether a late Bill for a tramway scheme for Hyde could be introduced into Parliament, and also whether private owners and others who have been served with notices by the Tramway Company would support the Corporation in this matter. There is to be an early conference with the Ashton Corporation. The Hyde Council wants to know under what authority the Ashton Corporation is supplying electrical energy for tramways in Hyde.

**Kidderminster.**—The Council has approved of the proposed tramway to Bewdley which the British Electric Traction Company desires to construct.

**Leamington.**—The proposal of the Leamington and Warwick Tramways Company to extend their line to Whitnash by the overhead trolley will not be opposed by the Parish Council.

**Liverpool.**—The work of relaying the lines for electric traction has been commenced at the corner of Green Lane, Tuebrook, and will be continued right along to Hengler's Circus.

At the Liverpool Coroner's Court on 8th inst. an inquest was held with reference to the death of Philip Graine, ropemaker, aged 73 years. Deceased was knocked down by an electric tramcar on December 29th and died in hospital on 6th inst. The driver admitted that he did not see him until the car was within 8 yards. Various statements were made as to the cars being run at a speed of more than the permissible 8 miles an hour, but the jury brought in a verdict of "Accidental death."

**Manchester.**—Deputations from the Stockport and Oldham Corporations have, by invitation of the Manchester Tramways Company, inspected the sample cars (now in the shed at Longsight) which will be used in Manchester so soon as the arrangements for working the tramways by electricity are completed.

**Mansfield.**—The Town Council has appointed Mr. Quin, electrical engineer, Blackpool, to advise the Council in respect to the proposed electrical trams which a syndicate proposes to lay between Sutton, Mansfield, and Mansfield Woodhouse. It was decided to oppose the scheme.

**Newcastle-on-Tyne.**—There has been a hitch in connection with the proposal to erect the tramways power station at the Manors, as the North-Eastern Railway Company has refused, for several reasons, to allow a siding at that point.

**Sheffield.**—In a report just submitted to the Council, Mr. Fell, the tramways electrical engineer, says that the Intake route is ready for the Board of Trade to inspect. The Hunter's Bar route cannot be opened until the beginning of March, because there will not be sufficient power available. The block on the railway has caused delay in the delivery of feeder pillars and steam pipes. In regard to the power house extensions, Messrs. J. Brown & Co. have nearly completed the four extra boilers, and the steam pipes have been delivered. Mr. Fell recounts certain troubles which have caused delay in the erection of the first large engine and dynamo. This will not be ready before March. The Electric Railway and Tramway Carriage Works, Limited, have delivered six special single-deck cars for the Intake route, and the Brill trucks were daily expected. Messrs. Milnes have also delivered six, and these are now being erected on Peckham trucks by the B.T.H. Co. In addition to a number of other cars which are on order, the Tramways Committee has now contracted with the Brush Electrical Engineering Company for 20 double-deck and 15 single-deck cars on Brill trucks for £11,000 odd, and with the B.T.H. Co. for 20 G.E.-52 and 15 G.E.-58 standard electric equipments for the above cars for £10,814.

The Board of Trade inspection of the Intake route took place on 8th inst., and the regular service of cars started on Wednesday. The section is just under 1½ miles, and it has some gradients 1 in 11 and 1 in 12, the average being 1 in 17 and 1 in 18.

**Sydney (N.S.W.).**—Two of the electric generators at the George Street electric tramway power station were tested satisfactorily toward the end of November last. The other two generators were then nearing completion.

**Walsall.**—The Brownhills Urban District Council have appointed a committee to consider as to various details not provided for in the Walsall Corporation Tramways Bill, and subject to their acceptance by the Corporation it has been resolved to support the Bill. At a meeting of the Walsall Town Council on Monday it was reported by the General Purposes Committee that an intimation had been received that, subject to certain renewals of portions of the line being carried out by the South Staffordshire Tramways Company within six months, it was the intention of the Board of Trade to renew the license for the use of electric traction for a further period of four years.

**Walthamstow.**—The District Council has entered into an agreement with Mr. Enright, electrical engineer, regarding the construction of the electrical tramway system.

**West Bromwich.**—The Council has passed a formal resolution to promote a Bill in Parliament with respect to the tramways and electric lighting.

(*Continued on page* 61.)

## ELECTRIC CRANES.

(*Continued from page* 847, *Vol.* 45.)

Some of the largest electric travellers built in this country have proceeded from the shops of Messrs. Joseph Adamson and Co., of Hyde. One of these, a 50-ton crane, is shown in fig. 19 in course of construction, while overhead are two cranes, for 5 and 15 tons respectively, which were also built by this firm. The large crane was destined for the "Cyclops" Steel Works of Messrs. Cammell and Co., Limited, the well-known armour-plate makers, and is truly Cyclopean in its dimensions. The girders are of the box type, of 62 feet span, 5 feet in depth at the centre, 3 feet at the ends, and 20 inches wide over the flanges; the end carriages are also of the box type, and the axle boxes of the running wheels are self-lubricated by means of rollers floating in oil baths. The travelling motion shaft is driven by a motor fixed at the middle of the crane, and gives a speed of 60 feet per minute, while the cross-travelling motion is operated at 40 feet, and the full load of 50 tons is hoisted at 3 feet per minute. The hook runs on ball bearings to facilitate rotation. The various motions are controlled from a cage carried at one end of the crane, with metallic resistances, &c.

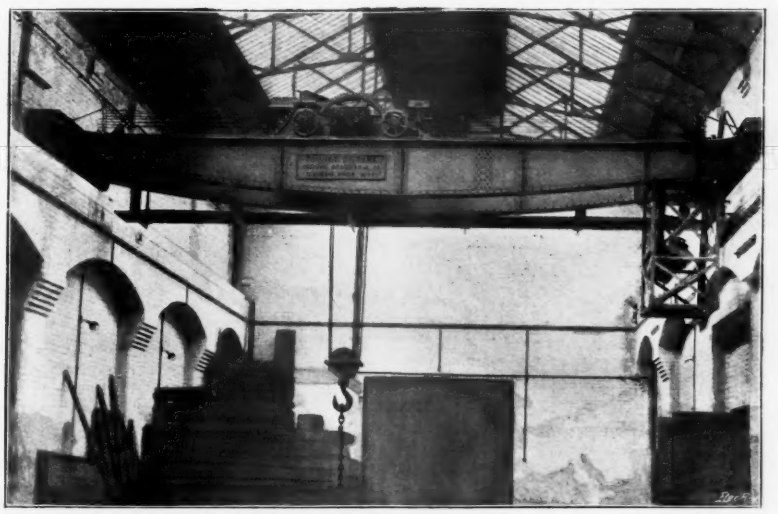


Fig. 20.—10-Ton Crane in Mr. Peter Brotherhood's Foundry.

It is a noteworthy feature of Messrs. Adamson's work that all their overhead cranes are erected in position over a large pit, and that when each crane is complete it is tested under actual working conditions by moving the test load, the pit being of such capacity as to allow a reasonable

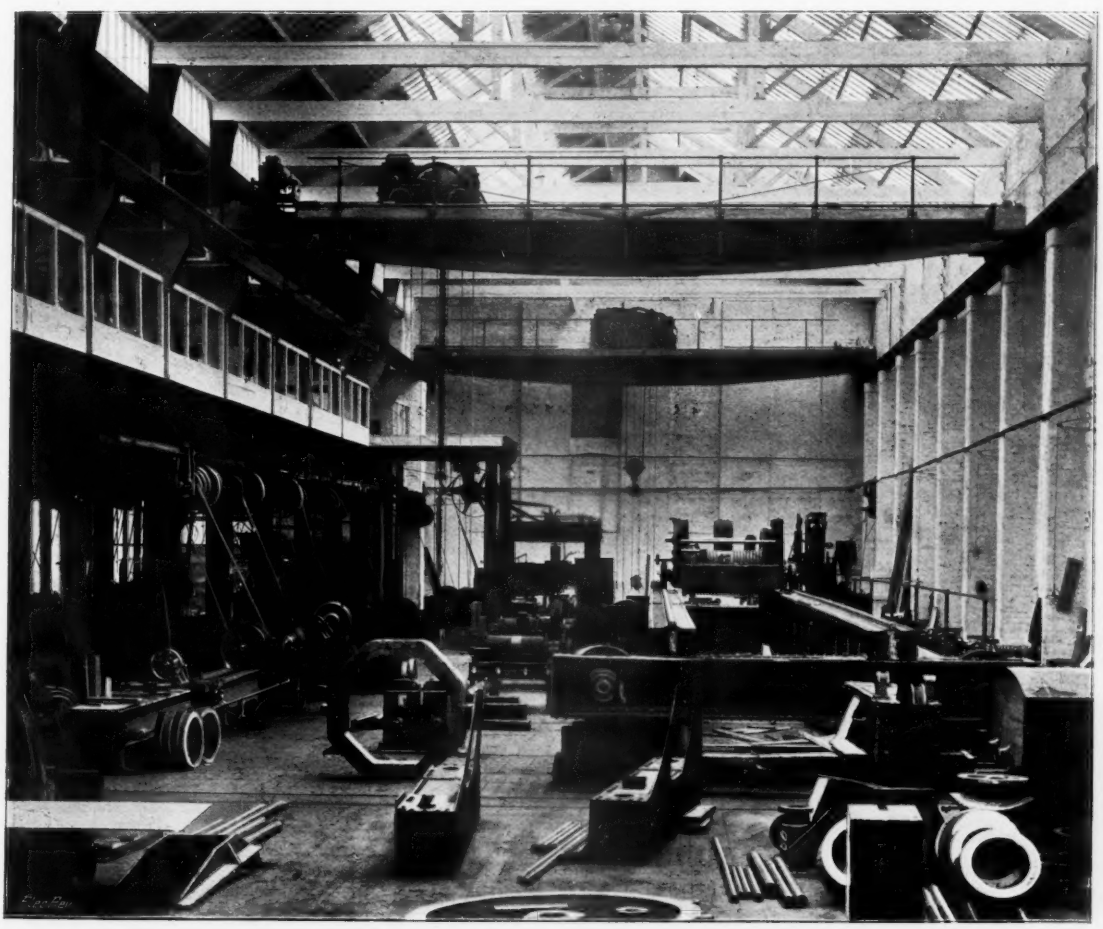


Fig. 19.—Messrs. Joseph Adamson & Co.'s Erecting Shop; 50-ton Crane in Course of Erection over Pit.

amount of movement for the hoisting and cross traversing motions, while the main wheels rest upon rollers to allow the longitudinal travelling motion to be worked also.

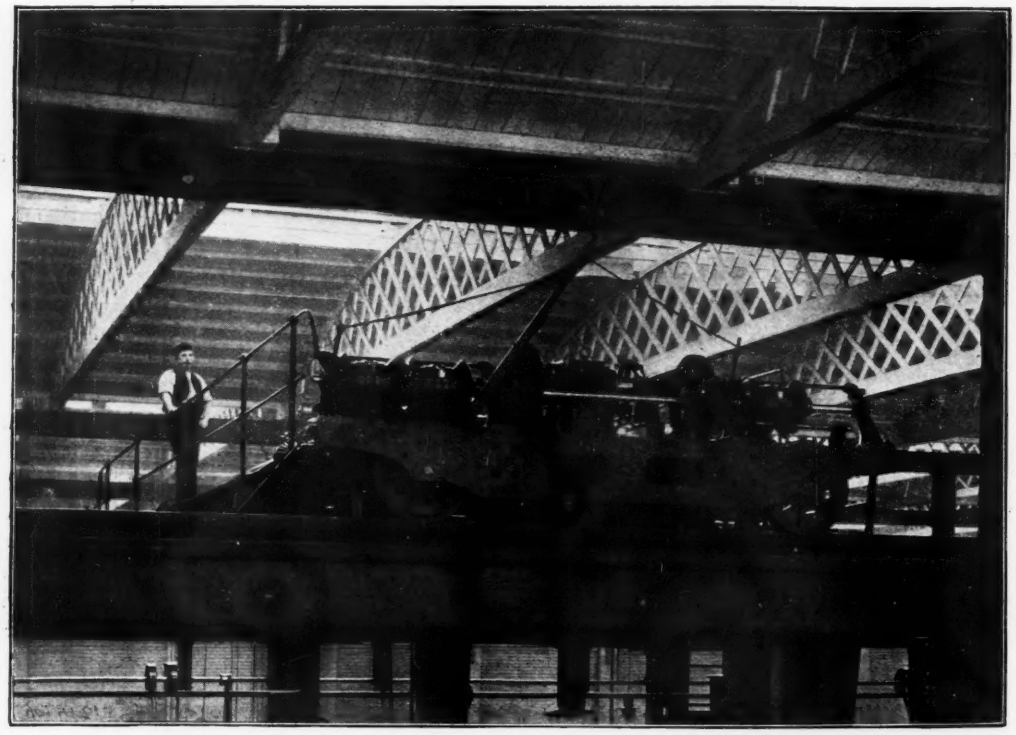


Fig. 22.

Fig. 21.—10-Ton Crane, in Messrs. Belliss & Morcom's Erecting Shop.

Every crane can thus be tested under actual working conditions, and it is found that considerable advantage is derived from this arrangement, as it ensures the crane being satisfactorily completed before being despatched, and enables it to be started as soon as it is erected at its destination. Also, any experiments which it is desired to make are much more readily carried out over the pit than when the crane is erected on a gantry.

Fig. 20 is a view of a 10-ton traveller, one of four supplied to Mr. Peter Brotherhood, of Westminster, in whose foundry

it is at work. This crane, unlike the other examples of Messrs. Adamson & Co.'s cranes which we illustrate, is controlled from a cage.

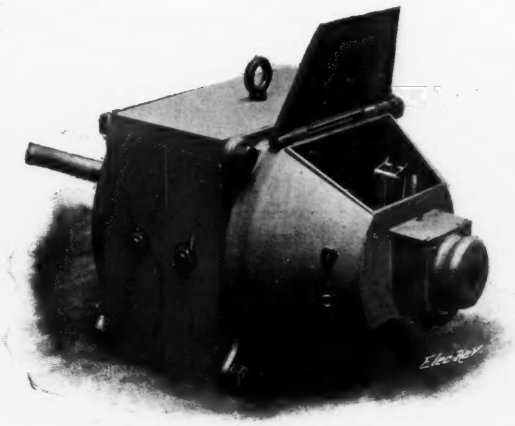


Fig. 23.

In fig. 21 is shown a 10-ton crane of a different pattern, particularly as regards the connection between the girders and the end carriages. Incidentally, the erecting shop of Messrs. Belliss & Morcom, Limited, to whom this crane and five others were supplied, is seen to advantage.

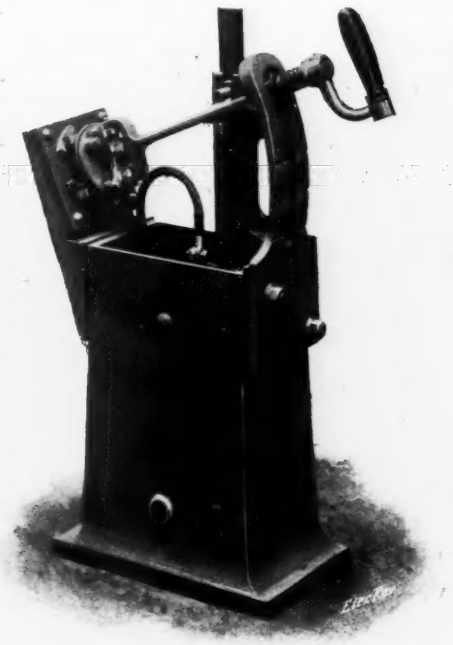
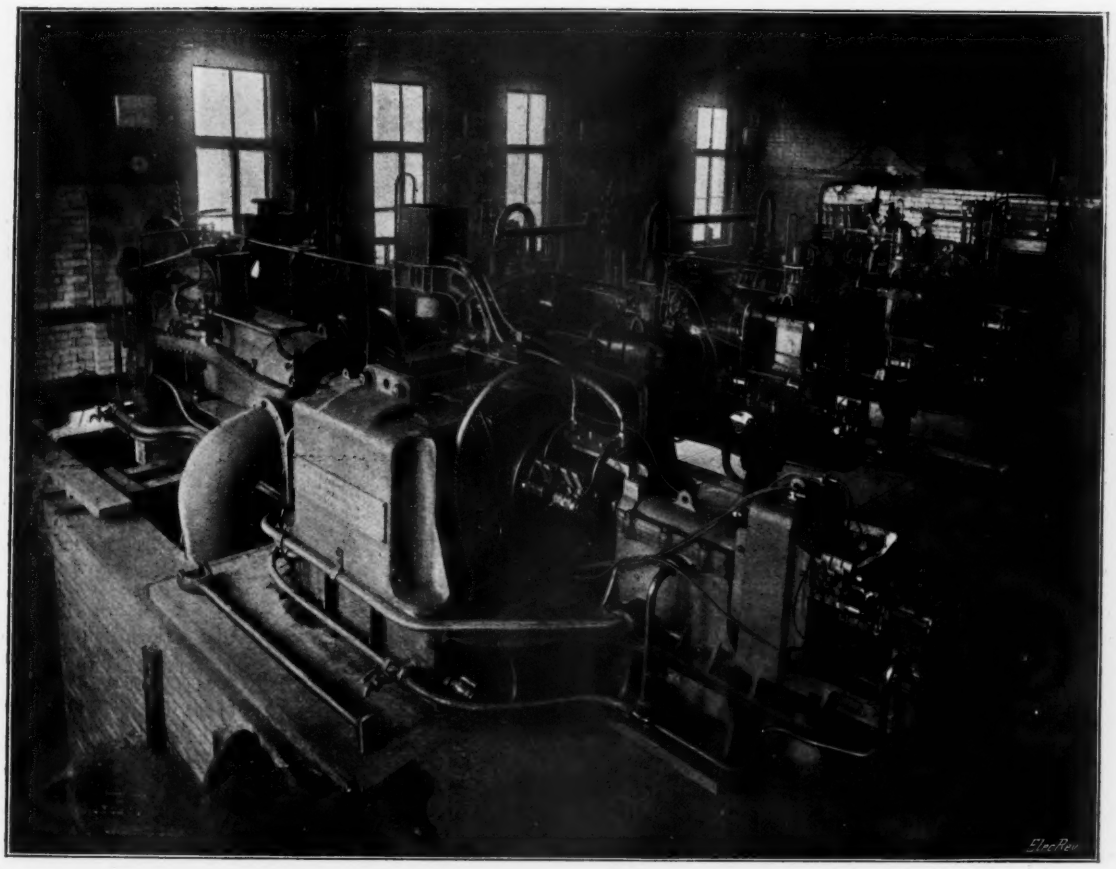


Fig. 24.



Cambridge.—500-kw. Steam Turbo-Alternator.

The switches on the side of the crab and the pendant ropes, by means of which the crane is controlled, are prominent in this view. It is a striking feature of the elasticity and handiness of electrical driving, that the complicated motions of a crane can be controlled with certainty from any desired point, whether on or off the crane.

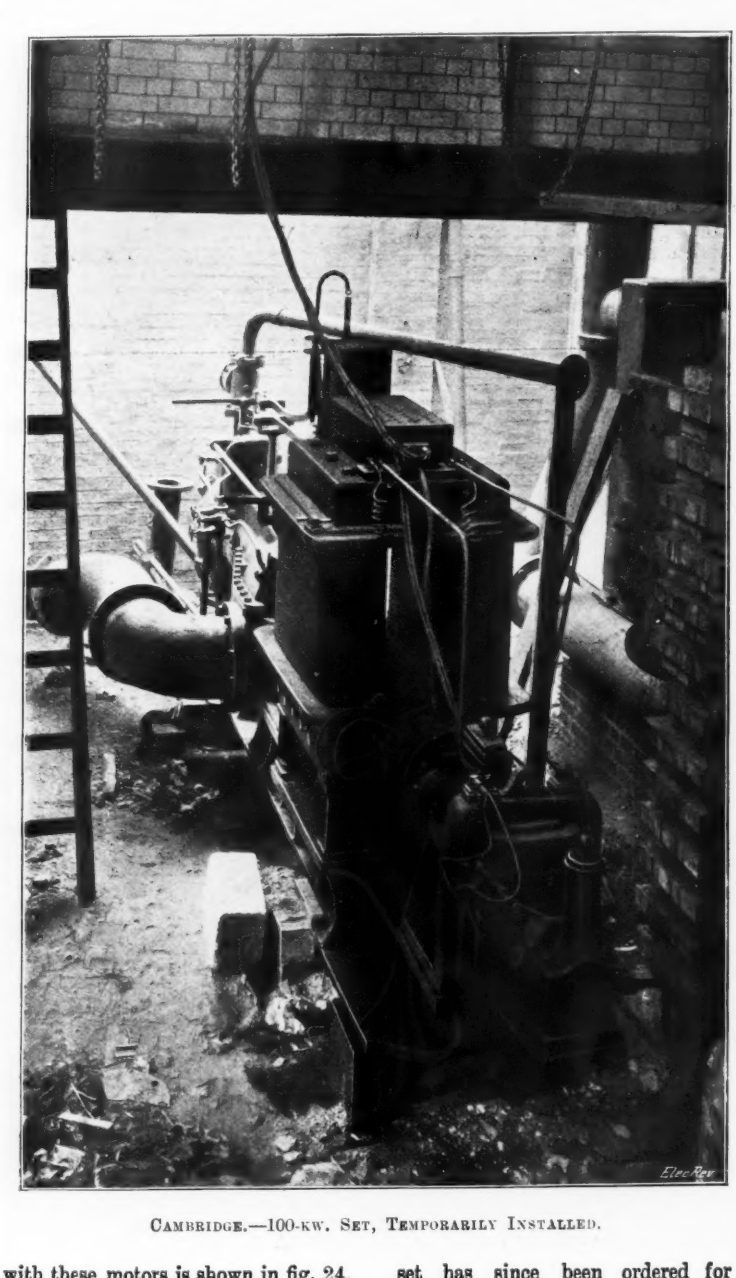
Turning to the special features of these travellers, it is a notable point that Messrs. Adamson invariably employ a separate motor for each motion, driving by spur gearing; the first pinion is forged solid with the motor spindle, which is of nickel steel, and the teeth, not only of this first reduction, but of all the other wheels and pinions, are machine-cut from the solid, except where shrouded or double-helical wheels are used at the slower end of the hoisting train.

All the pinions in the hoisting gear, as well as those gearing with the longitudinal travelling wheels, are of steel.

The hoisting motion is fitted with an automatic brake applied to a brake pulley on the spindle of the hoisting motor, the brake blocks being pulled off by electro-magnets; the latter are actuated by the passage of current to the hoisting armature. On the cessation of this current, either by accident or intention, the brake blocks are pulled against the rim of the brake pulley by springs, these being in duplicate to avoid the risk of failure if one of them should break.

In fig. 22 is shown an end view of an electric traveller made by Messrs. Carrick and Ritchie, and fitted with cone friction clutch reversing gear, which is well seen. This crane was equipped with an electromotor by Messrs. Thos. Parker, Limited, in whose erecting shop it is at work.

The motor in this case is of Messrs. Parker's ordinary open type. The firm, however, manufactures two forms of enclosed motor for use in places where damp and dirt are met with. One of these we have already illustrated, mounted on a swing pillar crane; the other form, Messrs. Parker's standard crane motor, is seen in fig. 23. This motor, which is completely ironclad, is of the two-pole type, the centre line of the poles being horizontal; there are two field magnet coils, wound practically on the poles, which are bolted to the frame. Carbon brushes are used, access to which is gained through the trap-door, and the bearings are provided with automatic lubrication. The motor runs at 500 revolutions per minute, taking a maximum input of 6,600 watts, and weighs about 1,300 lbs.




CAMBRIDGE.—100-KW. SET, TEMPORARILY INSTALLED.

The controller used with these motors is shown in fig. 24, and presents some interesting features of construction. As will be seen, it is of the liquid resistance type; the electrodes are raised and lowered by a bar sliding in vertical guides, and actuated by the handle-bar. The latter is pivoted upon a plate fixed to the back of the reversing switch, and is guided by the curved plate seen close to the handle. The slot in which the handle-bar travels is so shaped that the handle can only be turned when the bar is in its topmost position, with the circuit broken at the surface of the liquid resistance, while the curved plate is nicked at intervals to receive a spring catch on the handle, giving definite steps of resistance.

The result of this construction is, that it is impossible to cut off the current without leaving all the resistance in circuit, or to reverse the current without first switching off, while the direction in which the handle points shows which way the motor will run.

*(To be continued.)*

## A 500-KW. STEAM TURBO-ALTERNATOR AT CAMBRIDGE.

THE Directors of the Cambridge Electric Supply Company, Limited, having decided to put down a new alternator of considerably larger power than their present machines, they invited tenders from five leading English firms for a high-speed engine direct-coupled to a 500-KW. alternator. In reply they received tenders from each at the figures given below :—

*Without* condenser and pumps.

| | | |
|---|---|---|
| A | ... ... | £4,100 |
| B | ... ... | £5,456 |
| C | ... ... | £4,880 |
| D | ... ... | £5,010 |

*With* condenser and pumps.

| | |
|---|---|
| E (Parsons) | £4,884 |

In accepting the tender of Messrs. Parsons & Co., the directors were guided by the following circumstances :—The cost of a condenser and pumps, with an independent engine to drive them, was about £1,025, which fact reduced the tender of Messrs. Parsons to £3,799; a more serious consideration was that the space available in the present engine room would not accommodate a single set offered by the first four contractors, whilst it is possible to install two 500-KW. sets of the accepted design (as a matter of fact the second set has since been ordered for delivery during the present year), and in addition to the other advantages of turbine-driven plant, their guaranteed consumption of steam per KW.-hour for this size was lower than that of other makers. The figures in this case are given on next page.

| | 25 % overload. | Full load. | Half load. |
|---|---|---|---|
| A ... ... ... ... | ... | 28 lbs. | 34 lbs. |
| B ... ... ... ... | ... | 26 lbs. | 34 lbs. |
| C ... ... ... ... | 25·5 lbs. | 27 lbs. | 32 lbs. |
| D ... ... ... ... | ... | 26·6 lbs. | 31·2 lbs. |
| E (Parsons & Co.) ... | ... | 27 lbs. | 30 lbs. |

All were to have steam at 140 lbs. pressure and to be adapted for condensing.

The last figures include the power absorbed by the air and circulating pumps, and are without the 5 per cent. margin claimed in the other four (which is equal to another 1¼ lbs. of steam).

The plant was tested at the maker's works, Newcastle-on-Tyne, in October last by the company's engineer, Mr. John H. Barker; it will be remembered that the test was in progress at the time of our visit, and some of the results were given in our article describing the works. It was impossible to attach its own condenser, as this had already been delivered, and was built in position at Cambridge. As regards steam consumption the figures are comparable with the guarantees of the other four (excepting the margin of 1¼ lbs.); the condenser and pumps attached to the test house were used.

The tests extended over a period of 4 hours, and gave the results tabulated below:—

| | | | | |
|---|---|---|---|---|
| Boiler pressure, lbs. per sq. inch | 127 | 139 | 145 | 140 |
| Vacuum, inches ... ... ... | 24·75 | 24·5 | 26·5 | 27·5 |
| Barometer, inches ... ... | 29·6 | ... | ... | ... |
| Water per hour, lbs. ... ... | 13,400 | 12,675 | 7,029 | 4,180 |
| Output in KW. ... ... ... | 598 | 526·4 | 256·1 | 124 |
| Water per KW.-hour, lbs. ... | 22·4 | 24·1 | 27·5 | 33·7 |
| Exciting power, KW. ... ... | 3·5 | 3·3 | 3·1 | 3·0 |

When the engine is erected in position with its own condenser, it is hoped to get even better results, as a higher vacuum will be maintained than is possible with a condenser so far away from the engine as is necessary in a test house, and without the many branches on a trunk pipe.

So far as is known the figure of 22·4 lbs. of steam per KW.-hour at only 127 lbs. pressure has not been previously attained with a high-speed engine of this size, and a maintained efficiency down to one-quarter full load of only 33·7 lbs. is a remarkably good performance.

One of our views shows the set erected in position at Cambridge. The engine is of the usual parallel flow turbine type, and runs at a speed of 2,700 revolutions per minute; it is electrically governed, and can run in parallel with other alternators. Below the floor in a tunnel is a surface condenser, which is connected by a pipe on either side. The air and circulating pumps are on the same level as the condenser, and are driven from a worm and wheel; the worm has three threads, and is connected to an extension of the engine shaft at the high pressure end. This arrangement of driving air-pumps has been found satisfactory during the last four years; an engine with this attachment has run almost daily with the same worm wheel, which is still in excellent condition. The alternator is coupled direct to the engine; it is four-polar, with rotating armature, and delivers current at 2,000 volts, 90 periods per second. To the same shaft is coupled the exciter dynamo; this has a capacity of 5 KW., though only 3·5 are required at full load, or about 0·7 per cent. of the output.

It was impossible to deliver the engine in time for the winter of 1899, and the plant at the disposal of the company was not powerful enough to carry through without dangerous overloading; Messrs. Parsons & Co. therefore lent a 100-KW. non-condensing set to run pending the delivery of the larger machine. The second illustration shows this engine and alternator as it stood working in the basement of the engine room; it rested only on four blocks of timber laid on the bare earth. Three connections only were required—a 3-inch steam pipe, a 10-inch exhaust, and a pair of cables to the switchboard. The total cost of erection was something under £5. It is safe to say that no other class of plant can be so readily adapted in urgent cases, nor could a 200-I.H.P. engine of other build run on such simple foundations. In actual running the engine was the most silent in the place, and was quite as good in all other respects. In 1898 the directors let one of their engines and alternators to a town, whose heavy season was in the summer, to help it until it could obtain plant, and the engine was, in a few days after its return, at work and ready for the winter season.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 56.*)

**Wirral and Mersey Railways.**—The Wirral Railway Company have deposited a Bill for next session, the preamble of which recites that their railways could "be more satisfactorily and economically worked by electricity in addition to or in substitution for steam." In accordance with this preamble, the Bill proposes to confer on the company all the necessary powers to work their system by electricity, and for this purpose the company propose to create £180,000 additional capital, with the right to raise a further sum of £50,000 by the creation of debenture stock. Provision is also made in the Bill to enable the company and the Mersey Railway Company to become joint owners of any generating station which may be constructed by either company. In the event of any agreement being made for the joint use of any generating stations, it is proposed to vest the property in a joint committee, to be called the "Mersey and Wirral Electrical Joint Committee." This committee is to have power to apportion the amount of capital to be provided by each company, or, in lieu of requiring the two companies to pay their proportions, the committee may themselves issue "Mersey and Wirral joint electrical stock," which is to be a first charge on the revenue of the committee, and entitled to a perpetual fixed dividend not exceeding 4 per cent., which the two companies are empowered by the Bill to guarantee. A clause also provides that the Wirral Company may enter into agreements with the Wallasey Urban District Council, the Corporation of Birkenhead, or other public body for the supply to them of electricity.

## TELEGRAPH AND TELEPHONE NOTES.

**Continental Telegraphs.**—Direct telegraphic communication between Zurich and Vienna, and Zurich and London, was opened on 8th inst.

**Glasgow Telephones.**—The Corporation has received a letter from the Postmaster-General setting forth the conditions on which a license will be granted for the installation of a municipal telephone exchange. Certain general rules are laid down to secure the following results:—(1) An efficient local service within the area covered by the license; (2) easy access to the postal and telegraphic services of the Post Office; and (3) efficient inter-communication through the Post Office trunk wires between the subscribers to the exchange systems of other licensees and of the Post Office, and the subscribers in the area covered by the license. The Postmaster-General further states that he has no objection to the rates proposed on certain conditions, and he is willing to grant the license from the earliest period in 1900 to December 31st, 1913. The specification by the Postmaster-General was submitted by the Committee to Mr. A. R. Bennett, who takes exception to several of the clauses. In regard to wires placed underground, the Postmaster-General says the copper to be used shall weigh not less than 20 lbs. to the mile for short junction and subscribers' circuits, and 40 lbs. to the mile for junction circuits which exceed two miles in length. Mr. Bennett points out that the National Telephone Company uses wire weighing 12·54 lbs. to the mile for its underground cables. As to the 40 lbs. for longer wires, Mr. Bennett further shows that these weights are not imposed on the National Company, and the lighter wire serves every purpose. He therefore holds that the Corporation would be severely handicapped alike owing to the extra cost of the wire and its extra thickness. He also asks that power should be got to use any conducting metals except "iron" for the wires, owing to the high price of copper. In the matter of calling up the Exchange and ringing off, the Postmaster-General says these should be done by taking off and hanging up the telephone. Mr. Bennett opposes this method out and out, holding that it is an absolutely prohibitory one as regards upkeep, and, in addition, is about the most impracticable and worrying thing that could well be adopted. It was tried in Germany, and a change made at great cost on account of the expenditure on batteries being insupportable. The Committee having considered the report, decided to recommend the Corporation to acquiesce in the proposals of the Post Office, provided the representations in Mr. Bennett's letter were given effect to.

The National Telephone Company is seeking a conference with the Corporation, but the town clerk has replied that it would be hardly worth the company's while to send so far unless there was a reasonable possibility of there being some result from renewed negotiations. He asks whether the company is prepared to consider any modification of the rates at present charged.

**Manchester Telephones.**—Last week the Manchester City Council, though pressed in a letter from the Postmaster-General himself to come to a final decision one way or the other on the subject of municipal telephony, voted once again for delay and further consideration. The Post-Office communication explained that on the request of Salford and various other local authorities, a license covering those districts, and expiring in 1911, had been granted to the Mutual Telephone Company; but in view of the uncertainty as to the action of Manchester, power had been reserved to revoke the license at any time.

The town clerk of Salford has received a communication from the Postmaster-General with reference to the application of the Mutual Telephone Company, Limited, for a license to carry on the telephone exchange business within the borough. It states that a license terminating in 1911 "to transact such business in the borough of Salford and in the urban districts of Moss Side, Wilmslow, Stretford, Audenshaw, Gorton, Altrincham, Sale, Swinton, and Pendlebury" was accorded to the company on December 30th.

**Indian Telegraphs.**—*Indian Engineering* says that the direct copper wire between Calcutta and Madras has been laid, and it will be ready for use in a few days. It stretches from Calcutta to Dhond *vid* Manmad, while Dhond is linked direct with Madras in a similar manner. The Calcutta-Bombay and the Madras-Bombay connections will be completed by a wire from Dhond to Bombay.

**Lowestoft Telephones.**—The town clerk has had an interview with the representative of the National Telephone Company, and submitted draft agreement as to underground wires as drawn by the solicitors to the National Telephone Company. He was directed to write the National Telephone Company and ask whether they are prepared to give the same facilities to subscribers at Lowestoft as are given at Norwich. The draft agreement with the National Telephone Company with respect to the laying of underground wires was further considered, and the town clerk reported that, as directed by the General Purposes Committee, he had written to the district manager of the company as to whether the company is willing to grant the same facilities to subscribers at Lowestoft as have recently been granted to Norwich subscribers, and submitted a letter from him, dated 19th ult., stating that he is arranging for a canvass to be made of Lowestoft as to the new facilities which they are granting to their Norwich subscribers. The further consideration of the matter was deferred till Mr. Bennett and also Mr. Hawtayne have been consulted on the matter.

**Submarine Cable Contract.**—We hear that the Anglo-American Telegraph Company has placed a contract with the Telegraph Construction and Maintenance Company for the manufacture and laying of 80 miles of cable from England to Havre. This announcement is interesting in view of the fact that this is the first occasion upon which any party in the cable ring has gone outside among other cable makers with a request to tender for their requirements.

**Sydney Telephones.**—The Postal Department have had a return prepared showing the telephone business of the colony during the month of November, 1899. The number of telephones connected was as follows:—Central exchange, 6; branch and suburban exchanges, 51; country exchanges, 21; making a total of 78. A comparative statement for the three months gives the following results:—September, 109; October, 130; and November, 78; an average of 108. The total number of lines connected to November 30th was 9,408.

**Telegraph Construction Work and the War.**—Under the heading "The Royal Engineers and Telegraphic Communication," the *Times* publishes extracts from the private letters of a Royal Engineer officer, giving some glimpses of the very important work which is being done by the Telegraph Battalion of that force:—

"Belmont, November 25th.—The telegraph office is comfortably established in the post office, which is in a state of chaos, with two shell holes in the roof and numerous bullet holes. At De Aar we are occupying the time by drilling mules and horses and native drivers; also getting the Wheatstone automatic in order and drilling the men in pitching the tent for it and joining up, &c. . . . . There is more work in running 200 miles of wire and three or four offices than one would imagine.

"December 3rd.—I am in charge of our telegraph lines from De Aar to Modder River, and little things are always going wrong, but the messages get through somehow, and that is the chief thing. On Thursday I went up with a few men and stores to Modder River—50 miles in nine hours. At Orange River there is always a block, as there is not enough room, and, of course, it is only a single line everywhere.

"December 7th.—Last Sunday —— (No. 1 Section) arrived here and spent the night, with 125 men and transport, and started putting up a third line from here, and got to Modder River, having repaired all gaps, on Tuesday night. On Monday the permanent (Civilian P.O.) construction party arrived, and just as we had cut out our temporary wires and taken theirs in, a holdfast gave way, and the wires were useless till 5.30 p.m. On Tuesday, after much difficulty and bother, we finally got three lines working—one through from the front to De Aar, one from front to here, and then to Orange River and De Aar, and one railway line. That night —— went up to the front with the Wheatstone automatic. On Wednesday they opened it, and it worked well at the rate of 250 words a minute. When I woke this morning I found native platelayers had come in with information that the Boers were between Graspan and Enslin, *i.e.*, about 13 miles north of here, and had blown up a culvert and cut the telegraph line at 4.30 a.m. We thought it was probably a small party, who would cut the line and bolt. About 7.30 a.m. a sub. of the Munster Fusiliers with 15 men and self with six of mine and some material, and some half-dozen mounted men as escort, set out in a truck and engine to investigate. When we got near Graspan we saw men through my glasses on the kopje two miles ahead. We thought they were our men from the next post, and went cautiously on till at about 2,500 yards from the kopje we were greeted with a shell, which landed about 50 yards in front of us. We promptly stopped. Another fell 20 yards behind, going within a few yards of us. We then thought discretion the better part of valour, and retired out of range. We saw Boers all along the ridge, and heard when we got back that 2,000 Boers had been reported there. They fired another shell as we retired, but it fell short, and none of them exploded.

"December 9th.—Yesterday morning a few of the railway sappers and 50 Gordon Highlanders left here at 4.30 a.m. to start repairing the line, and I went off in a truck and engine with my men and 10 Gordons. The telegraph was down for nearly two miles, and the railway was torn about a lot and a culvert blown up. We got the wires up about 3 p.m. and the railway mended by 5 p.m., but it was hard and thirsty work.

**The United States Government and the Eastern Extension Telegraph Company.**—The following extract from the recent report of the Chief Signal Officer of the United States, is interesting as bearing upon the position of telegraph cables in war time. General Greely writes as follows:—

The question of cable communication in the Philippines early assumed a serious phase. Only a few days prior to the opening of the Spanish-American war the Eastern Extension, Australasia and China Telegraph Company, under an emergency contract, doubtless stimulated by the approach of hostilities, extended the Hong Kong cable, which previously landed on the northern coast of Luzon, to the city of Manila. This cable was cut, as has been reported, by Admiral Dewey, who endeavoured in vain to obtain a neutralisation of the cable, it being understood that the Spanish reports would be allowed to pass over it if the United States could also utilise it. This Spain, through its officers, refused to permit, despite every effort on the part of the Chief Signal Officer of the Army to secure the reopening of this cable.

In obedience, as it was understood, to the demands of the Government of Spain, from whom this company was receiving a subsidy, the cable was officially sealed at Hong Kong, and remained dead during the entire war. The Chief Signal Officer of the Army immediately took steps to furnish cable communication, and through the efforts of Lieut.-Col. Richard E. Thompson, Signal Corps, a cable was laid between Manila and Cavite—a most fortunate action, since during a period of 10 months following, communication to Cavite by land telegraph lines was interrupted and business could be transacted direct only over the Signal Corps cable. In addition, arrangements were made as speedily as possible for the manufacture in the United States of deep-sea cable sufficient in quantity to provide for military operations in the Philippines. As soon as this was learned the Eastern Extension Telegraph Company immediately questioned the right of the United States Army to lay cables in the Philippines—a remarkable position, inasmuch as this company not only refused to open its own cables, but coupled with it a claim for absolute cable rights, and a demand that the United States Government should wait for cable facilities until the Philippines came into its possession by treaty of peace.

It is needless to say that the Government sustained the Chief Signal Officer of the Army in his view that the United States Army had a right to lay, for war purposes, cables in any part of the Philippine Archipelago that might be within its control.

After consultation with the commanding general Department of the Pacific through Lieut.-Col. Richard E. Thompson, the Chief Signal Officer of the Army undertook to provide sufficient submarine cable and lay it between such points in the islands of Luzon, Leyte, Cebu, Negros, Panay, Masbate, &c., as might be selected by the Major-General Commanding and occupied by United States troops. The intention was to supplement these series of cables by short land lines.

Despite the attitude of the Eastern Extension Telegraph Company the plan contemplated did not look to interference with existing lines, but simply provided cable communication between Manila and Cebu and the Visayan Islands by an absolutely different route from that formerly occupied by the Eastern Extension Telegraph Company.

It should be noted at this time that the Eastern Extension Telegraph Company abandoned with the Spanish troops the cable stations occupied in the Visayan Islands in December, 1898, and that the entire system of Visayan cables, from Manila south through the islands of Panay and Negros to Cebu, was interrupted and cable communication impossible. This resulted from the abandonment of these stations by the Eastern Extension Telegraph Company, which was coupled with the announcement, as reported, that they were unwilling to occupy these stations until the United States was able to protect their officers and property. This was commercially prudent, but diplomatically it could not fail to place the United States in the position of being unable to control the territory which it was to acquire by a treaty of peace then awaiting action of Congress.

The action of the Eastern Extension Telegraph Company, a British corporation, in abandoning its stations at Iloilo and elsewhere broke up the system of lines south effectually. If they had continued to occupy these offices, it seems probable that as a neutral corporation they could have secured the continuous operation of the Spanish landlines, which were necessary for the completion of the system. Cable interruption was followed, however, by the operation of the landlines by insurgents hostile to the United States, so that these important connecting links were not only temporarily lost to the United States, but absolutely passed into possession of hostile forces.

Later the Eastern Extension Telegraph Company brought up the question of its concessions, and from that time on has lost no opportunity or effort to wrest from the United States Government an acknowledgment of the legality and continuance of such concessions, that provide for the payment of heavy subsidies and exemption from taxation of the property and lines of a foreign corporation, which grant a cable monopoly in the Philippines for the next 42 years.

The Chief Signal Officer of the Army recommended unfavourable action on all of these applications and was eventually supported by the Administration, the Attorney-General having decided that the present was not an opportune moment for passing upon concessions or privileges in the Islands of Cuba, Porto Rico, or the Philippines.

It is proper for the Chief Signal Officer of the Army to state briefly the reasons for his opposition to the definite recognition of these concessions:

First, it is a judicial matter which should be passed upon by the highest courts in the Philippines and eventually in the United States.

Second, the treaty convention at Paris declined to recognise or provide for any of the telegraph concessions brought before it.

It may be suggested that the subsidies for cable operations in the Philippines formed an obligation against the Government of Spain, which entered into a contract for absolute rights, a contract apparently contrary to the policy of Congress for the past 100 years: moreover, these pecuniary obligations might possibly be considered as forming a part of the Philippine debt.

There are certainly provisions in the late Spanish concessions to this cable company which plainly cannot be acceded to by the United States, especially the absolute cable rights for an indefinite period, not only in the Philippine Archipelago, but in all Spanish possessions in the Pacific. As has been pointed out, the United States adheres to its right to lay war cables, and it is questioned whether Germany, in its newly acquired Caroline Islands, acknowledges the absolute right of the British company to lay cables in that portion of the former Spanish possessions.

The final adjustment of these matters is without the scope of duties pertaining to the Chief Signal Officer of the Army, who deems it important to simply present to the Secretary of War the questions raised during the past year and the methods and reasons involved in their treatment.

**The Telegraph Wire Export Trade.**—The last month of the year just closed proved to be a very quiet one as regards the exports from this country of telegraph wire and apparatus connected therewith. The returns just issued show that during December the value of such shipments only amounted to £46,964, as against £260,239 in the preceding month, £41,250 in the last month of 1898, and £172,140 in December, 1897. Taking the returns for the whole of 1899, however, they show that the past year has, in this branch, been the most active for a long period, the year's shipments having attained a value of £1,407,783, as against only £985,283 in 1898, and £997,802 in 1897.

**Telephonic Communication in Italy.**—The Italian Minister of the Posts has granted a 25 years' concession to a private company for the establishment and working of telephone exchanges in the towns of Arezzo, Pistira and Prata, and for the establishment of telephonic communication between Florence, on the one hand, and and Prata, Pistira, Arezzo, Siena and Pisa on the other.

### Telegraphic Interruptions and Repairs:—

| CABLES. | Down. | Repaired |
|---|---|---|
| WEST INDIES:— | | |
| Jamaica-Colon ... ... ... | June 30, 1899 ... | ... |
| Trinidad-Demerara (1891 duplicate) ... ... ... ... | Oct. 23, 1899 ... | ... |
| SOUTH AFRICAN:— | | |
| Zanzibar-Mombasa ... ... | Oct. 26, 1899 ... | ... |
| Mozambique-Lourenço-Marques | Dec. 17, 1899 ... | ... |
| Cayenne-Pinheiro ... ... ... | Oct. 11, 1899 ... | ... |
| Latakia-Cyprus ... ... ... | June 20, 1899 ... | ... |
| Gibraltar-Tangier ... ... ... | Jan 1, 1900 | Jan. 4, 1900. |
| Tarifa-Tangier ... ... ... | Jan. 3, 1900 ... | ... |
| Iquique-Valparaiso ... ... ... | Jan. 9, 1900 ... | ... |
| Serena-Valparaiso ... ... ... | Jan. 9, 1900 | Jan. 10, 1900. |
| **LANDLINES.** | | |
| WEST INDIES:— | | |
| Communication with Les Cayes (Haiti) ... ... ... ... | Nov. 21, 1899 ... | ... |
| SOUTH AFRICAN:— | | |
| Communication with Mafeking and beyond ... ... ... | Oct. 13, 1899 ... | ... |
| Communication with all offices beyond Orange River ... ... | Oct. 18, 1899 ... | ... |
| Communication with north of Mooi River (Natal) ... ... | Oct. 22, 1899 ... | ... |
| Colombian Government lines to Bogota ... ... ... ... | Oct. 21, 1899 ... | ... |
| Communication with Colombia ... | Nov. 3, 1899 ... | ... |
| Communication with Valentia (Venezuela) ... ... ... | Nov. 10, 1899 ... | ... |

**Wireless Telegraphy on Channel Steamers.**—It is stated in the *Times* that the general manager of the South-Eastern and Chatham Railway, Mr. Alfred Willis, has made arrangements with the Wireless Telegraph and Signal Company for the Marconi system to be used in the course of a few weeks on the company's Royal Mail steamers between Dover and Calais, and also on their Royal Mail steamers between Folkestone and Boulogne. By this arrangement the steamers, when in mid-Channel, or half an hour from either the French or English shores, will have telegraphic communication with either side. The telegraph will, however, be used for service purposes only, and no messages will be accepted from the public for transit. One pole erected at Dover will command both fleets, either in crossing the Channel or in port on the other side of the water. This will save the expense of clerks and of the erection of poles at Folkestone, Boulogne, and Calais, as, owing to the short distance across the Channel, the ships' masts will be sufficiently high for the purpose. When the pole has been erected at Dover, communication by wireless telegraph can be maintained with the Ostend boats, if the Belgian Government desire; but in their case, the distance being greater, the erection of a pole at Ostend will probably be necessary.

**Wireless Telegraphy in the U.S. Navy.**—The New York *Electrical Review* says that Rear-Admiral Bradford, Chief of the Bureau of Equipment of the U.S. Navy, will shortly establish stations at Newport, R.I., and on Coaster's Island, near by, where classes will be formed to begin the work of developing wireless telegraphy. The decision to equip the station is said to be due to the exorbitant terms demanded by Mr. Marconi and his company, which contemplated a minimum of $20,000 a year rental for such instruments as he might furnish. It has been definitely decided to abandon the Marconi system and strike out in a new direction. The experiments conducted on board the *New York* and *Massachusetts* were highly unsatisfactory, and showed that in fleet formation the interference of messages would be so great as to destroy the usefulness of the system. Admiral Bradford believes that the navy will be able to develop a system of telegraphy without wires that will surpass in usefulness that of the Italian inventor. The signal service of the army is now conducting its own experiments along its own lines, and General A. W. Greely reports that these have met with gratifying success.

## CONTRACTS OPEN AND CLOSED.

**Aberdeen.** — January 22nd. The Electric Lighting Committee wants tenders for a 420-KW. direct coupled continuous current dynamo. See "Official Notices" January 5th.

**Barking.**—January 23rd. The Urban District Council wants tenders for two continuous current transformers and switchgear, underground cables and roadworks for the Creeksmouth electric lighting extension. See "Official Notices" December 29th.

**Beira.** — The Companhia de Mocambique is inviting tenders for laying down plant for electrically lighting the town of Beira (Portuguese East Africa) and for working same for 25 years. See "Official Notices" January 5th.

**Belfast.**—February 8th. The Electric Committee wants tenders for 400-KW. steam dynamos. See our "Official Notices" January 5th.

**Bermondsey.**—January 13th. The Vestry wants tenders for the construction, &c., of a dust destructor, with furnaces, water-tube boilers, economiser, fans and forced draught appliances, in connection with the electricity supply undertaking. See "Official Notices" December 15th.

**Birkenhead.**—January 16th. The Corporation is inviting tenders for the construction of a new electricity generating station in connection with the electric tramways.

**Germany.**—January 24th. The Prussian State Railway authorities at Frankfort-on-Maine, are inviting tenders until the 24th inst., for the supply of 270,000 arc lamp carbons. Particulars may be obtained for 6d. from, and tenders to be sent to, Die Königliche Eisenbahn Direction, Frankfort-on-Maine.

**Glasgow.**—January 29th. The Corporation invites tenders for the supply and fitting up of a hydraulic or electric lift. Plans and specifications on application to Mr. Thomas Young, consulting engineer, 4, West Regent Street, on payment of a fee of £1 1s.

**Hull.**—January 24th. The Electric Lighting Committee invites tenders for 30 cast-iron section pillars each containing eight switch fuses, &c. See "Official Notices" to-day.

**Ilford.**—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-kw. and one 100-kw. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" December 15th.

**Melbourne.**—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" December 22nd.

**Newcastle-on-Tyne.**—January 24th. The Corporation wants tenders for laying down about 11 miles of double line tramway, the rails, fastenings, and the poles being supplied by the Corporation. See "Official Notices" December 22nd.

**Plymouth.** — January 31st. The Corporation wants tenders for a 500-KW. steam dynamo (motor generators, &c.); a 500-KW. steam alternator, &c.; accumulators; Lancashire boilers and equipment; mains. See "Official Notices" January 5th.

**Sheffield.**—January 20th. The Electric Lighting Committee invites tenders for steam and exhaust pipes and jet condenser for the electricity works. See "Official Notices" January 5th.

**Spain.**—January 16th. Tenders are being invited until January 16th by the municipal authorities of Utrera for the concession for the electric lighting of the town by means of 300 10-C.P. lamps and 100 16-C.P. lamps. Tenders to be sent to El Secretario del Ayuntamiento de Utrera (Spain) whence particulars may be obtained.

**Sunderland.**—The Corporation wants tenders for a tramways switchboard. See "Official Notices" to-day.

**Tunbridge Wells.**—January 15th. The Corporation invites tenders for condensing plant to deal with 30,000 lbs. of steam per hour. See "Official Notices" December 22nd.

**Tunbridge Wells.**— January 25th. The Corporation wants tenders for a 400-KW. steam alternator. See "Official Notices" January 5th.

### CLOSED.

**Birkenhead.**—For the Southend electricity generating station, condensing plant has been ordered from Mr. A. Wenner, of Manchester; the feeder mains will be supplied by the British Insulated Wire Company, and the overhead traveller by Messrs. Carrick and Ritchie.

**Bradford.**—The City Council on Tuesday agreed to place an order with the Electricité et Hydraulique Société Anonyme, Charleroi, Belgium, for 100 car equipments instead of 75, as originally arranged. The chairman of the Tramways Committee said that they would require 100 in two and a half years, and they had had an offer of 10 per cent. reduction if they increased the order to that number within a fortnight. By that arrangement they would save £80 per car, or £2,100 on the order.

**Gloucester.**—In "Electric Lighting Notes" this week we give particulars of accepted tenders for boiler, steam dynamo, switchboard work and condensing plant.

**Hammersmith.**—The Vestry has accepted the tender of Mr. T. L. Hillyar, of Hammersmith, for wiring and installing the Vestry's stables and depôt in Fulham Palace, W.

**Islington.**—The Vestry has given an order for condensing plant to the Wheeler Condenser Company at £4,290. The highest tender was £6,655.

**Leeds.**—The County Council has given a contract for the construction of seven transformer chambers to Messrs. J. Schofie'd, Sons & Co., at £2,298. There has been some amount of quibbling about paying the standard rate of wages to builders' labourers in connection with this contract.

**Melton Mowbray.**—Messrs. C. A. Parsons & Co., have received from Edmundson's Electricity Corporation, Limited, the order for two 75-KW. condensing type, turbo dynamos, for the electric lighting of the above town.

**Morecambe.**—The tenders of Messrs. T. Parker, Limited, and Messrs. Callender's Cable and Construction Company, for extensions at the Council's electricity works, have been accepted subject to the Local Government Board giving their consent to the loan.

**Rathmines.** — The Rathmines and Rathgar Urban District Council, at their meeting on Wednesday, 3rd inst., had under consideration the report of their consulting engineer, Mr. Robert Hammond, M.I.C.E., upon the tenders received by them for the extension of the electricity supply mains, when the offer of the British Insulated Wire Company, Limited, was accepted. Tenders were received from the following firms:—

| | |
|---|---|
| W. F. Dennis & Co., London .. .. .. .. .. | £4,125 |
| British Insulated Wire Company, Ltd., Prescot (accepted) | 4,130 |
| St. Helen's Cable Company, Limited, Warrington .. | 4,311 |
| Callender's Cable and Construction Co., Ltd., London | 4,374 |
| W. T. Henley's Telegraph Works Company, Ltd., London | 4,523 |
| W. T. Glover & Co., Limited, Salford .. .. .. .. | 4,701 |
| Western Electric Company .. .. .. .. .. | 4,724 |

**Sheffield.**—Orders for 35 cars and electric equipments for same, have been given to the Brush Company and the British Thomson-Houston Company, by the municipality. (See "Traction Notes," this week.)

**Walsall.**—The Town Council on Monday accepted the tender of Messrs. Bumsted & Chandler for supplying and fixing one of their three-throw crank compound Chandler engines for the sum of £980, also the tender of Messrs. Thomas Parker, Limited, Wolverhampton, for supplying a new dynamo at a cost of £924.

## FORTHCOMING EVENTS.

**Friday, January 12th.**—At 8 p.m. Institution of Civil Engineers. Students' meeting. Address by Prof. T. Claxton Fidler, M.Inst.C.E., on "The Theory of Structures and Strength of Materials."

**Thursday, January 18th.**—At 8 p.m. Chemical Society. Among papers to be read is one on the "Electrolysis of Nitrogen Hydrides and of Hydroxylamine," by E. C. Sharvasy, Ph.D.

**Tuesday, January 16th.**—At 8 p.m. The Institution of Civil Engineers. Further discussion on (1) "The Purification of Water after its Use in Manufactories," by Reginald A. Tatton, M.Inst.C.E.; and (2) "Experiments on the Purification of Waste Water from Factories," by W. O. E. Meade-King, M.Inst.C.E. Paper to be read (time permitting):—"Swing Bridges over the River Weaver at Northwich," by J. A. Saner, M.Inst.C.E.

**Wednesday, January 17th.**—At 8 p.m. Society of Arts. Arthur Rigg on "Ventilation without Draughts."

At 7.30 p.m.—Grand Hotel, Manchester. Special meeting of the Northern Society of Electrical Engineers to add to the rules. (See a "Note" in this issue.)

**Thursday, January 18th.**—At 8 p.m. The Institution of Junior Engineers. At the Technical College, Finsbury, Leonard Street, City Road (by invitation), Lecture, illustrated by experiments, &c., on "The Balancing of Engines," by Prof. W. E. Dalby, M.A., M.Inst.C.E.

**Friday, January 26th.**—At 9 p.m. Royal Institution. The Hon. C. A. Parsons on "Motive Power, High-Speed Navigation, Steam Turbines."

**Friday, January 26th, at 5 p.m.** Physical Society. 1. "Some Developments in the use of Price's Guard Wire in Insulation Tests." By Prof. Ayrton and Mr. Mather. 2. "Reflection and Transmission of Electric Waves along Wires." By Dr. E. Barton and Mr. L. Lownds. 3. "The Frequency of the Transverse Vibrations of a Stretched India-rubber Cord." By Mr. T. J. Barker.

## NOTES.

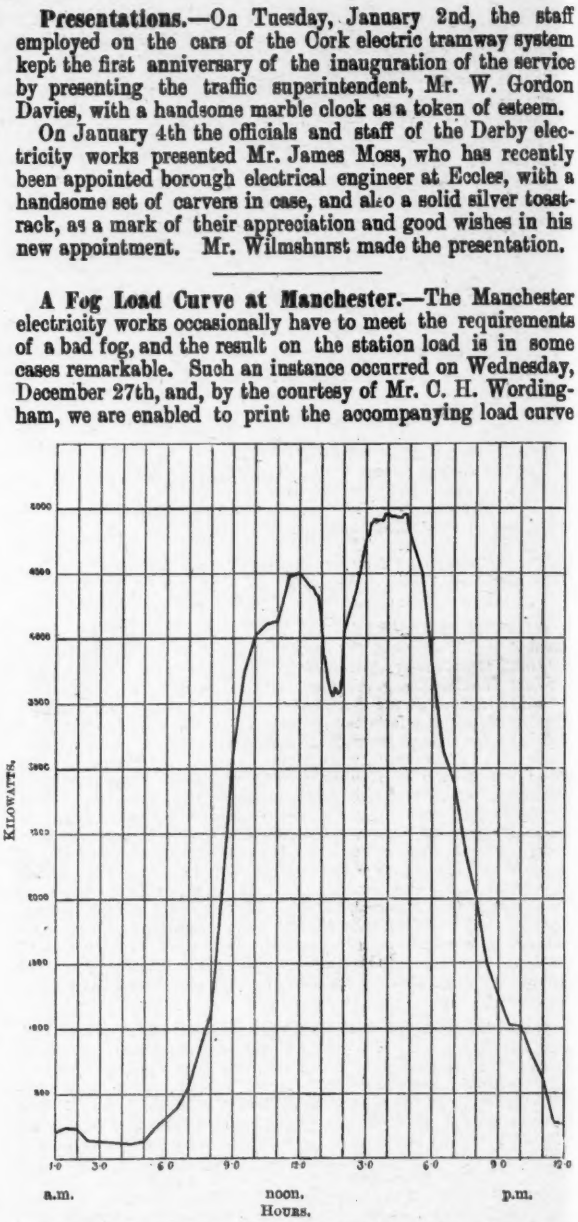
**1900.**—Our friends and readers generally, especially those who have new catalogues to get out, will be interested to know that the Universal Electrical Directory (the Red Book) for this year is now being sent out to subscribers as fast as copies can be obtained from the binders' hands. We hope to be able to issue the work to the general public early next week. (See advertisement page 39.)

**The Swiss Photographs.**—The Swiss Visit Committee has selected a number of photographs from those exhibited, and it has been arranged for these to be enlarged and mounted in an album at cost price. Those who are desirous of possessing one of these interesting collections should place themselves in communication with Mr. R. S. Erskine, of 22, Stanford Road, Kensington, by January 22nd.

**Presentations.**—On Tuesday, January 2nd, the staff employed on the cars of the Cork electric tramway system kept the first anniversary of the inauguration of the service by presenting the traffic superintendent, Mr. W. Gordon Davies, with a handsome marble clock as a token of esteem.

On January 4th the officials and staff of the Derby electricity works presented Mr. James Moss, who has recently been appointed borough electrical engineer at Eccles, with a handsome set of carvers in case, and also a solid silver toast-rack, as a mark of their appreciation and good wishes in his new appointment. Mr. Wilmshurst made the presentation.

**A Fog Load Curve at Manchester.**—The Manchester electricity works occasionally have to meet the requirements of a bad fog, and the result on the station load is in some cases remarkable. Such an instance occurred on Wednesday, December 27th, and, by the courtesy of Mr. C. H. Wordingham, we are enabled to print the accompanying load curve




MANCHESTER CORPORATION ELECTRICITY WORKS; LOAD CURVE AT DICKINSON STREET GENERATING STATION, WEDNESDAY, DECEMBER 27TH, 1899.

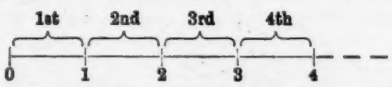
for that day. The very marked drop between 1 and 2 o'clock is due to the stoppage of the large motor load, upwards of 1,500 H.P., which is supplied from the *continuous current* mains.

**Electrical Engineers for the Front.**—We understand that Mr. W. A. Fraser, the Lancaster Corporation's electrical engineer, who is a sergeant in the Middlesex Yeomanry, has left for service in South Africa. The Mayor and members of the Corporation gave him a very hearty send off at the railway station, and his fellow officials presented him with a valuable pair of Zeiss field glasses, which will be useful while scouting. The Corporation, besides granting leave of absence, have made him a handsome allowance.

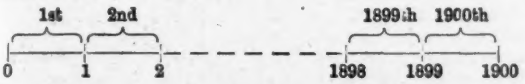
We also learn that Mr. G. F. A. Norman, A.I.E.E., mains superintendent to the Harrogate Corporation, has volunteered for active service at the front in the Royal Suffolk Hussars (Yeomanry), and has passed the necessary examinations. His post is to be kept open for him.

It is announced that Mr. R. E. Crompton, with 50 men of the Electrical Engineers Volunteers, and six search lights, have offered their services to the War Office for South Africa. If this offer is accepted, a number of members of the Chelmsford electrical firm will join the detachment for foreign service.

**A Fin-de-Siècle Problem.**—As if it were not enough to have a great war on our hands, in addition to the smoke nuisance and tested lamps, we have for some weeks been subjected to a correspondence debate in the *Times* on the question *which* end of the century we are living in. So long as this discussion was confined to Sir Courtenay Boyle and other lay victims, we held aloof from the strife; but a letter which recently appeared in the *Times* from the hand of Mr. Chas. Bright impels us to settle the matter, lest other members of the profession should be attacked by the disease. Mr. Bright's view is that because the marks on a foot-rule start at 0, and only reach 1 after traversing a space of 1 inch, therefore the Christian era began at 0. Of course it did. But Mr. Bright proceeds to assume that time stood still at 0 for the period of one year. Of this we have grave doubts. Such phenomena only occur in the case of the weaker sex, and then only after the 22nd birthday. The fallacy lies in the confusion of units. In measurement of length the figures marked on scales denote the limits of exact multiples of a certain unit, and apply to *points* only; in recording time the figures are employed to distinguish *periods*, and are never applied to *points* of time. Thus, the point 3 on a foot rule means the limit of a length of 3 inches and is placed at the end of the *third inch*, and *every point between* 2 *and* 3 *is in the third inch*. Thus:—




In the same way 1899 years have elapsed at the end of the 1899th year, and 19 centuries—*i.e.*, 19 hundreds—cannot be completed until the end of the 1900th year, which is now current:—




If it is difficult to grasp large numbers, let us try a simple analogy: When is it the seventh day of the week?—Any time on Saturday. When are seven days completed?—At the end of Saturday. When does the new week commence?—On the *first day* of the new week (not on the day numbered 0, but on the day numbered 1), and one day is complete at the end of the *first* day. Having thus ended the matter, we hope to hear no more about it. Anyhow, whatever the Emperor of Germany may say, we are still at the fag-end of a century. We only hope that, in spite of his declaration that the Institution dinner was his last for the 19th century, Sir Courtenay Boyle will think again, and eat his dinner, even at the cost of eating his words?

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**Appointments Vacant.**—The Manchester Corporation wants a chief assistant electrical engineer to assist the city electrical engineer in carrying out the electrical engineering work required in connection with the tramways. See "Official Notices" this week.

The Hertfordshire County Lunatic Asylum at St. Albans, is wanting an electrical engineer. The Leith Corporation wants a shift electrical engineer for the electricity works. A telegraph foreman is wanted for the Gold Coast Telegraph department at £250 per annum. See "Official Notices" this week.

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**Electric Cranes for Middlesbrough.**—For the equipment of their new docks at Middlesbrough, the directors of the North-Eastern Railway Company have decided to erect 17 3-ton and 3 10-ton electrically-driven cranes, also 24 capstans. The work has been placed with Messrs. Siemens Bros. & Co., Limited, in conjunction with Messrs. Cowans, Sheldon & Co., Limited, who are to be responsible for the mechanical part of the undertaking. In addition to the cranes, the railway directors have entrusted to Messrs. Siemens the complete outfit of the generating station, consisting of engines, boilers, dynamos, switchboards, pumps, and cables for driving the cranes. The output of the central station is to be 1,000 E.H.P. This undertaking will form the largest installation of electric cranes in the United Kingdom.

**Tests of Aluminium Wire for Fire Alarm Purposes.**—We read in our New York namesake that Mr. E. B. Ellicott, city electrician of Chicago, has instituted practical tests of aluminium wire in Chicago for fire-alarm service. The wire will be left up all through the winter, in a location parallel with railway tracks, where it will be subjected to fumes and smoke from locomotives. One span 225 feet long crosses the tracks; another piece is under test in another part of the city under similar conditions and alongside a new copper wire of the same size, so as to give comparative results. The comparative tests made on copper and aluminium wire before erection gave the following results:—

| Metal. | Twists in 6 inches. | Breaking weight in pounds. | Elongation in 5 feet (inches). | Weight per mile in pounds. |
|---|---|---|---|---|
| No. 10 hard-drawn copper wire ... ... ... ... | 55 | 515 | $3\frac{1}{16}$ | 173 |
| No. 10 aluminium ... ... | 27 | 275 | $1\frac{1}{8}$ | $51\frac{1}{2}$ |

It is interesting to note, says the *Telegraph Age*, that although the copper wire gave greater elongation and number of twists, the breaking weight of the aluminium wire was more than half that of the copper wire of the same size, while the actual weight of the wire was less than one-third.

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**Personal.**—Mr. F. J. A. Matthews, who has been for $4\frac{1}{2}$ years designer and chief electrical engineer to Messrs. Ashton, Frost & Co., Limited, of Blackburn, has resigned that position, as he has been appointed electrical engineer to the Vulcan Boiler and General Insurance Company.

Mr. C. E. C. Shawfield, Wolverhampton borough electrical engineer, was, at the Town Council meeting on Monday, appointed gas examiner to the Corporation for the purpose of testing the illuminating power and purity of the gas supplied by the Wolverhampton Gas Company. This will not interfere with Mr. Shawfield's appointment as electrical engineer.

The Public Lighting Committee of the Eccles Town Council has appointed Mr. James Moss, Derby, electrical engineer to the Corporation at a salary of £200 per annum. There were 32 applicants.

Mr. R. A. Dawbarn has resigned the position of superintending engineer to the Brush Electrical Engineering Company, in order to take up consulting practice.

Mr. A. H. Roe, of Bradford, has been appointed resident electrical engineer of the Bury electricity works, at a salary of £150 per year for the first six months, and from that term £180 per year.

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**Lectures.**—On Thursday last week Mr. R. H. Scotter, C.E., delivered a very interesting lecture on "Locomotion: Past, Present, and Future," at Northwich. Under the "future" arrangements came references to the employment of electricity for traction purposes, and some comments on the proposed Warrington—Northwich light electric railway.

On Thursday, 18th inst., Prof. Oliver J. Lodge will lecture before the Glasgow Lecture Association on "Wireless Telegraphy."

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**Electric Lighting at Northallerton.**—On Monday, 8th inst., the public lighting of Northallerton was inaugurated. Arc lamps of the Solar long-hour type are used for the main thoroughfares, and a considerable number of incandescent lamps for lighting the side streets and lanes. One of the novel features is the adoption of aluminium conductors for the overhead mains. The present plant consists of two generating sets, and considerable extensions are being carried out as the works are not sufficient to cope with the present demand for public and private supply. The works have been designed and carried out to the specifications of Mr. J. Ernest Hutton, A.I.E.E., to whom the formation of the Northallerton Electric Light and Power Company is due.

**Coal Economy.**—At the time we laid before our readers the discussion on Mr. Holliday's and Mr. Crompton's Institution of Electrical Engineers' papers dealing with the cost of steam raising, we mentioned that Mr. A. J. Lawson had prepared some useful tables, showing how the steam consumption of engines and cost of coal might be co-related. On the question of relative cost, Mr. Lawson pointed out that he had found the cost of repairs to furnaces, &c., where Welsh coal is burned, to work out at about ·033d. per unit, while in the case of North Country rough small coal, automatically stoked, the figure rose to ·150d., or 4½ times more. With rough small North Country coal there is a greater quantity of ash and clinkers to be removed, and this has been found to be from two to three times greater in the case of the small bituminous coal than in the case of Welsh coal. But against this must be set the higher cost of Welsh coal, which, in London, is at least 50 per cent., although the evaporative value is only 25 per cent. greater. Certain qualities of rough small coal, with good automatic stoking, will evaporate 8 lbs. of water per pound of coal, while Welsh coal will evaporate 10 lbs. With an overall efficiency of engine and direct coupled dynamo or alternator of about 80 per cent., or, say, 600 watts effective per I.H.P., the cost of fuel per unit generated, assuming no other losses, will be as under :—

Cost of Fuel per B.T.U. generated with an overall efficiency of about 80 per cent. (or 600 watts per I.H.P.) when burning North Country rough small coal, evaporating 8 lbs. of water per pound of coal, and the ton of coal when delivered into the coal store costing :—

| Pounds of steam per I.H.P.-hour. | 10s. | 12s. | 14s. | 16s. | 18s. |
|---|---|---|---|---|---|
| 20 | ·223 | ·268 | ·312 | ·357 | ·402 |
| 19 | ·212 | ·255 | ·296 | ·339 | ·382 |
| 18 | ·201 | ·241 | ·281 | ·321 | ·362 |
| 17 | ·190 | ·228 | ·265 | ·303 | ·342 |
| 16 | ·178 | ·214 | ·250 | ·286 | ·322 |
| 15 | ·167 | ·201 | ·234 | ·268 | ·301 |
| 14 | ·156 | ·188 | ·218 | ·250 | ·281 |
| 13 | ·145 | ·174 | ·203 | ·232 | ·261 |
| 12 | ·134 | ·161 | ·187 | ·214 | ·241 |
| 11 | ·123 | ·147 | ·172 | ·196 | ·221 |
| 10 | ·112 | ·134 | 156 | ·179 | 201 |
| Half of above figures per unit generated = a cost per ton of | 5s. | 6s. | 7s. | 8s. | 9s. |

Cost of Fuel per B.T.U. Generated, with an overall efficiency of 80 per cent. (or 600 watts per I.H.P.) when burning Welsh coal evaporating 10 lbs. of water per pound of coal, and the ton of coal delivered into the coal stores costing :—

| Pounds of steam per I.H.P.-hour. | 14s. | 16s. | 18s. | 20s. | 22s. | 24s. |
|---|---|---|---|---|---|---|
| 20 | ·250 | ·286 | ·321 | 357 | 393 | ·429 |
| 19 | ·237 | ·272 | ·3 5 | 339 | ·373 | ·408 |
| 18 | ·225 | ·257 | ·289 | 321 | 354 | ·386 |
| 17 | ·212 | ·243 | ·273 | ·303 | 334 | ·365 |
| 16 | ·200 | ·229 | ·257 | ·286 | 314 | ·343 |
| 15 | ·187 | ·215 | ·241 | ·268 | ·295 | ·322 |
| 14 | 175 | 200 | ·225 | ·250 | ·275 | ·300 |
| 13 | ·162 | ·186 | ·209 | ·232 | ·255 | ·279 |
| 12 | ·150 | ·172 | ·192 | ·214 | ·236 | ·257 |
| 11 | ·137 | ·157 | ·177 | ·196 | ·216 | ·236 |
| 10 | ·125 | ·143 | ·161 | ·178 | ·196 | 215 |
| Half of above figures per unit generated = a cost per ton of | 7s. | 8s. | 9s. | 10s. | 11s. | 12s. |

**Aluminium Telegraph Wire.**—The American Postal Telegraph Company has reached the conclusion that aluminium wire is preferable to copper for telegraph wires, in view of the high price of the latter, and in extending its lines will make use of it for the purpose.

**Accumulator Traction.**—New York *Electricity* says :—"According to reports, the storage battery cars operating in Berlin, Conn., have not proven satisfactory, and the lines will shortly be changed to the overhead trolley."

**English Electricians for the Westinghouse New Works.**—The *Western Electrician* of Chicago, which came to hand by yesterday's mail, contained the following interesting note :—"A short time since the *Western Electrician* pointed out the possibility of openings for young Americans of technical training in the manufacturing and operating establishments of an electrical nature springing up in Great Britain. A recent paragraph in an English trade journal tends to confirm this view. In connection with the establishment of Westinghouse works at Manchester, it is stated that the British company recently incorporated for that purpose has made arrangements for sending a number of young Englishmen to acquire a complete knowledge of the methods adopted by the Westinghouse companies at Pittsburg, and of the plant and equipment of which they make use. These young men for the most part have already acquired a theoretical knowledge of the electrical work, and their American experience will, it is proposed, be limited to about12 months of good, practical work. On their return to Europe they will be placed in situations of trust in the British works of the company. The British Westinghouse Company seems to desire specifically Englishmen trained in Westinghouse ways, but the need of the American training seems to give a hint that may be useful to graduates of American shops and schools. However, the young American engineer or electrician should bear in mind that men of practical experience are preferably wanted, and that the environment and immediate remuneration to be obtained abroad are likely to be different from what he has been led to expect at home."

**A Complete Heat Cycle for the Steam Engine and Boiler.**—A curious paper has been presented to the Engineering Association of New South Wales by Mr. L. C. Auldgo. It is not very clearly put together, but the line of thought taken is that old and familiar one that the latent heat of steam is all thrown away in the condensing water and represents an enormous waste of fuel. The author's method, so far as we can gather, is to use an evaporative condenser whereby the latent heat of the steam rejected by an engine is transferred to the water outside the condenser. The effect is increased in the usual way by means of a fan, and the mixed products, the air and vapour, are sent forward to feed the furnace. Now, it is perfectly clear that unlike liquid water the vapour will not require to absorb any heat of vaporisation in the furnace, but that it will simply acquire some addition to its temperature, but we fail to see how this places matters in any better condition. The vapour certainly cannot part with any heat to the boiler; for it enters the furnace at probably 120° at most, and more probably at a very much less temperature; and it enters the chimney probably at 350° at the very least. Now, there can be no possible economy in this so far as regards mere heat transference. But the author claims as much as 29 per cent. of economy. We do not deny the possibility of some economy. Moisture is said to be a necessary accompaniment of smokeless combustion. Dry oxygen is not favourable to perfect combustion, some moisture must be present. This is what would be expected, but the author says it would not be expected, from which we may infer that he is not fully acquainted with recent investigations. The author wrongly claims his novel cycle as a means of affording pure water for the boiler feed, which is pure nonsense, for any surface condenser of evaporative or any other type will give this. The facts may be as he states them, and a real economy may have been effected, though we doubt anything like 29 per cent. We are not disposed to doubt the smoke prevention. The whole experiment was very small, and the uneconomical results were obtained when two fans were used—one for the condenser and one for the boiler draught; whereas, when the economical rims were made, the one fan for the condenser supplied the furnace also; in so small a test the difference would be considerable. This seems to have been left unaccounted for, and may account for so large an apparent economy. It is, finally, just possible that the system may be economical, and if it be so, the getting rid of the vapours of a water cooler or condenser would be worth attempting, but Mr. Auldgo must not run away with any idea that he has found a new cycle of heat, for he has not done anything of the kind, and the disposal of the latent heat of exhaust steam still remains an unsolved problem, except where plenty of heating is wanted done.

**A Large Water Rheostat.**—In a paper read at the November meeting of the American Institute of Electrical Engineers, and abstracted in the *Electrical World*, Mr. E. J. Willis gave the results of a test on a 300-KW. direct-connected railway generator at different loads. The efficiency (electrical horse-power per indicated horse-power) was 63 per cent. at a load of 110 KW.; 74 per cent. at 160 KW.; 79 per cent. at a load of 219 KW., and 79 per cent. at a load of 275 KW. The engine is of the horizontal tandem compound condensing type. In making the tests a water rheostat was used, consisting of two sheets of boiler plate, 5 feet by 6 feet each. By means of soda the conductivity of the electrolyte was brought to the desired point, and after the water got boiling thoroughly, the load could be maintained perfectly steady. At the load of 275 KW. about 15 square feet of each plate was submerged. In using a water rheostat the author advises that if a steady load is required, it is well to let the water come to a boil and the plates remain steady, replacing the water evaporated by a small stream constantly flowing in.

## NEW COMPANIES REGISTERED.

**Cheltenham Engineering Company, Limited** (64,697.)—This company was registered on January 4th, with a capital of £8,000 in £1 shares, to carry on the business of mechanical and electrical engineers, ironfounders, cycle and motor car manufacturers and merchants, hardwaremen, &c. The first subscribers (each with one share) are:—E. S. Rawson, 54, Old Broad Street, E.C., colonial agent; H. E. Freshwater, 60, Brisbane Street, E.C., clerk; A. O. Chudleigh, 54, Old Broad Street, E.C., gentleman; W. H. Pendred, 27, Star Street, Bryswater, W., clerk; A. Kift, 54, Old Broad Street, E.C., Australasian merchant; J. M. Tharp, Mill Hill, N.W., gentleman; and G. Adams, 14, South Road, Reigate, gentleman. The number of directors is not to be less than three nor more than five; the first are to be appointed by the subscribers; remuneration, £100 each per annum.

**J. W. Manley & Co., Limited** (64,671).—This company was registered on January 2nd, with a capital of £3,000 in £1 shares (2,000 preference), to acquire the business carried on at 39, Victoria Street, S.W., to adopt an agreement with J. W. Manley, and to carry on the business of electrical engineers, founders, contractors, generators, storers, accumulators, and distributors of electricity and other power. The first subscribers (each with one share) are:—J. G. Machan, 1, Mincing Lane, E.C., tea broker; J. H. Balleece, 39, Victoria Street, S.W., merchant; M. M. Campbell, 13, Ashley Place, S.W., gentleman; S. Mackay, 39, Victoria Street, S.W., clerk; J. W. Manley, 39, Victoria Street, S.W., engineer; R. Bode, 25, Victoria Street, S.W., agent; and A. Field, Kingscliffe, Woodville Road, New Barnet, contractor's manager. The number of directors is not to be less than two nor more than five. The first are J. W. Manley and J. H. Batten; qualification, £100 ordinary shares.

**Reason Manufacturing Company, Limited** (64,701).—This company was registered on January 5th, with a capital of £50,000 in £1 shares, to acquire the business of the Reason Manufacturing Company, Limited (incorporated 1891), to acquire from the Mutual Electric Trust, Limited, certain patents and patent rights relating to inventions connected with the distribution, measurement, and utilisation of electrical energy, and to carry on the business of electrical engineers, electricians, and suppliers of electricity for all purposes. The first subscribers (each with one share) are:—H. Reason, 60, Grand Parade, Brighton, engineer; W. Paddison, 150—4, Western Road, Brighton, draper; W. Corderoy, 13, Richmond Road, Brighton, engineer; H. Chier, 4, Stafford Road, Brighton, accountant; F. V. Hobbs, 31, Queen's Road, Brighton, estate agent; L. A. R. F. Kenward, 142, Westborne Street, Hove, clerk; F. M. Lewis, 36, West Hill Road, Brighton, electrician; and H. C. Hughes, 7, York Villas, Brighton, secretary. Henry Reason is the governing director, and may retain office so long as he holds one-fifth of the issued capital. Qualification of ordinary directors, £100, or, being a director of the Mutual Electric Trust, Limited; remuneration as fixed by the company.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Kalgoorlie Electric Power and Lighting Corporation, Limited** (63,248).—This company's statutory return was filed on December 22nd, when 150,000 shares had been taken up out of a nominal capital of £225,000 in £1 shares (25,000 deferred). 5s. per share has been called up, resulting in the receipt of £32,423 5s., leaving £5,076 15s. in arrears.

**Winchester Electric Light and Power Company, Limited** (50,868).—This company's annual return was filed on November 1st, when 2,207 shares had been taken up out of a nominal capital of £25,000 in £5 shares. £10,375 has been paid, leaving £160 unpaid.

**Blackheath and Greenwich District Electric Light Company, Limited** (47,875).—This company's annual return was filed on December 13th, when 101,200 shares had been taken up out of a nominal capital of £150,000 in £1 shares. 100,855 has been paid, leaving £345 in arrears.

## SUPPLY STATION ACCOUNTS.

**Islington Vestry Electricity Accounts.**

The accounts of the Islington Vestry electricity supply undertaking indicate that the business is rapidly extending, and as the electrical engineer, Mr. Albert Gay, says, "The results of the year's working may be considered as satisfactory," and he is entitled to "have every confidence that the success of the undertaking is now assured." The Islington Vestry is, however, one of the few undertakers who omit to attach to the yearly accounts the Board of Trade form giving particulars of the units sold and load reached, and this is an omission we should like to see made good in future accounts.

The increase in output and revenue is clearly shown by a table which appears in the yearly report attached to the accounts, and which is as follows:—

Increase Over Previous Year.

| | Total units sold. | Units sold. Number. | Units sold. Percentage. | Revenue. Amount. | Revenue. Percentage. |
|---|---|---|---|---|---|
| 1896 ... | 298,000 | ... | ... | ... | ... |
| 1897 ... | 504,000 | 206,000 | 69 | £4,716 | 62 |
| 1898 ... | 911,000 | 408,000 | 81 | £9,021 | 73 |

A considerable reduction in price was made to private consumers at the end of 1897, and was therefore seriously felt by the department during the whole of 1898.

General Statement.

| | 1897. | 1898. | Increase. |
|---|---|---|---|
| Total capital expenditure ... | £144,228 | £188,518 | £44 290 |
| Number of units sold ... | 503,572 | 911,571 | 407,999 |
| Total maximum load ... | 585 KW. | 800 KW. | 215 KW. |
| Gross revenue ... ... | £12,216 | £21,438 | £9 222 |
| Gross profit ... ... | £4,358 | £9 092 | £4,734 |
| Average price per unit sold ... | 5·59d. | 5·44d. | — ·15d. |

The scale of charges was in 1897, we believe, 7d., 6d., and 5d. respectively for the first, second, and third hours' daily use of the maximum demanded supply and 4d. for further hours. This was reduced by the elimination of the 5d. rate, and in 1898 the rates were 7d, 6d., and 4d. As will be seen from the Revenue Statement, this led to a drop of ·15d. per unit in the revenue derived from sale of current. Meter rents appear at the same value per unit, but other sources of revenue have fallen by ·03d. collectively, the total reduction being at the rate of ·18d. per unit. The average per unit sold still remains, however, as high as nearly 5½d. The public lighting accounted in 1898 for 403,012 units, bringing in £8,396, against £4,030 in 1897.

Revenue Statement.

| | 1897. Gross. | 1897. Per unit. | 1898. Gross. | 1898. Per unit. | Increase. |
|---|---|---|---|---|---|
| Sale of current ... | £11,728 | 5·59d. | £20,658 | 5·44d. | — ·15d. |
| Meter rents (less interest on deposits) | 180 | ·08d. | 293 | ·08d | ... |
| Rents received and bank interest ... | 271 | ·13d. | 444 | ·11d. | — ·02d. |
| Sundry fees, &c. ... | 37 | ·02d. | 43 | ·01d. | — ·01d. |
| Gross revenue | £12,216 | 5·82d. | £21,438 | 5·64d. | — ·18d. |

The costs of production show an increase of nearly $\frac{1}{10}$d. in the coal bill. No doubt this is largely due to the coal strike, and the enhanced rates charged for coal which particularly affected the London stations. "Repairs," as might be expected, have gone up, but all the other items show a drop; this amounts to a ½d. in the total costs.

Cost of Production.

| | 1897. Gross. | 1897. Per unit. | 1898. Gross. | 1898. Per unit. | Increase |
|---|---|---|---|---|---|
| Coal ... ... ... ... | £2,393 | 1·14d. | £4,614 | 1·22d. | + ·08d. |
| Oil, waste, water, and engine room stores. | 783 | ·37d. | 1,222 | ·32d. | — ·05d. |
| Salaries and wages incurred in generation and distribution. | 1,981 | ·94d. | 2,979 | ·78d. | — ·16d. |
| Repairs and maintenance of buildings, engines, boilers, dynamos, &c. | 561 | ·27d. | 1,087 | ·29d. | + ·02d. |
| Works' costs ... ... | £5,718 | 2·72d. | £9,902 | 2·61d. | — ·11d. |
| Rent, rates and taxes ... | 477 | ·23d. | 665 | ·18d. | — ·05d. |
| Management and expenses, salaries of managing engineer, secretary, clerks, &c. | 916 | ·44d. | 1,643 | ·27d. | — ·17d. |
| General establishment charges, stationery and printing, law charges and insurance | 655 | ·31d. | 612 | ·17d. | — ·14d. |
| Other expenses ... ... ... | 92 | ·05d. | 94 | ·02d. | — ·03d. |
| Total costs ... | £7,858 | 3·75d. | £12,346 | 3·25d. | — ·50d. |

The two years' accounts analysed show the turning point of the business from a net loss of over £300 to a net profit of over £2,200, and it may be noted that the increase in interest and redemption charges is almost exactly equal to the net profit for 1898. The undertaking is, therefore, well on the way to wipe out the accumulated net losses incurred since its inception.

Profit Statement.

| | 1897. | 1898. |
|---|---|---|
| Interest on loans .. .. .. .. .. | £3,621 | £4,945 |
| Sinking fund for repayments .. .. .. | 1,055 | 1,940 |
| Net profit carried forward .. .. .. | −318* | 2,207 |
| Gross profit ... ... | £4,358 | £9,092 |

* Deficiency carried forward.

## CITY NOTES.

### Fleetwood and District Electric Light and Power Syndicate, Limited.

The first annual meeting of this company was held at Fleetwood some days ago, Mr. J. G. Seed presiding. The directors' report read as follows:—

The directors beg to submit for the consideration of the share and debenture holders the enclosed balance-sheet and revenue account to December 31st, 1898. They have to report that the installation has now been almost completed, and it is hoped that a supply of electrical energy may be available for lighting and motive power before the end of March. Owing to the very great activity in the building and engineering trades, there has been some unavoidable delay in the completion of the various contracts. Everything has, however, been carried out to the complete satisfaction of Mr. F. H. Medhurst, the syndicate's consulting engineer, so that the directors are confident that, on completion of the whole scheme, the proprietors will be possessed of an efficient and thoroughly up-to-date installation. All the streets of Fleetwood are to be electrically illuminated, and the demand by private consumers has, so far, been most encouraging.

The report and balance-sheet were adopted.

Mr. Medhurst reported that all the mains had been laid. The engines and dynamos were in position. Everything was in a finished condition, with the exception of the steam pipes connecting the boilers and engines. This piece of work amounted to £200 or £300, and was the only amount out of contracts of about £20,000 that was incomplete. When this was done they would be able to start and supply the consumers. The destructor was as good a one as could be obtained in the country. They expected the works to be finished long before March, although that was the time estimated in the report. There had been 109 applications, and the number of lights amounted to 2,700 or 2,800, exclusive of the town lighting.

**Stock Exchange Notices.**—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to St. James's and Pall Mall Electric Light Company, Limited—further issue of 8,020 ordinary shares of £5 each, fully paid, Nos. 52,081 to 60,100; and to allow the following securities to be quoted in the Official List:—Western Telegraph Company, Limited—further issue of 565 shares of £10 each, fully paid, Nos. 205,994 to 206,558.

## TRAFFIC RECEIPTS.

**The Bristol Tramways and Carriage Company, Limited.**—The receipts for the week ending January 5th, 1900, were £2,766 6s. 2d.; corresponding period, 1899, £2,506 4s. 0d.; increase, £260 2s. 2d.

**Blackpool and Fleetwood Tramroad Company.**—The receipts for six days ending January 6th, 1900, were £140 17s. 8d.; receipts for corresponding period, 1899 (seven days), £166 9s. 6d.; aggregate for half-year to date, £140 17s. 8d.

**The City and South London Railway Company.**—The receipts for the week ending January 7th, 1900, were £1,144; ditto January 8th, 1899, £1,143; increase £1. Miles open, 3½.

**The Dover Corporation Tramways.**—The receipts for the week ending January 6th, 1900, were £158 19s. 1d.; January 7th, 1899, £155 0s. 7d.; increase, £3 19s. 6d. Total receipts to date, 1900, £158 19s. 1d.; corresponding period, 1899, £155 0s. 7d.; increase, £3 18s. 6d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,948; 1899, 4,179. Number of cars, 1900, 11; 1899, 11.

**The Dublin United Tramways Company.**—The receipts for the five days ending Friday, January 5th, 1900, were as follows:—D. U. T. Co., horse cars, £77 3s. 2d.; ditto, electric cars, £2,058 19s. 6d.; D. S. D. Co., electric cars, £415 16s. 5d.; total, £2,551 19s. 1d.; corresponding week last year—D. U. T. Co., horse cars, £1,454 1s. 6d.; ditto, electric cars, £390 8s. 5d.; D. S. D. Co., electric cars, £438 16s. 11d.; total, £2,283 0s. 10d.; increase, £268 18s. 3d. Worked:—The mileage open is 40 miles electrically, 4 miles by horses, as against 15 miles electrically, and 28 miles by horses, for the corresponding period last year.

**The Liverpool Overhead Railway Company.**—The receipts for the week ending January 7th, 1900, amounted to £1,455; corresponding week last year, £1,349; increase, £116.

**The South Staffordshire Tramways Company.**—The receipts for 5 days ending January 5th, 1900, were £406 4s. 3d.; 5 days ending January 6th, 1899, £457 17s. 6d.

## STOCKS AND SHARES.

Wednesday Evening.

While business still shows itself shy of returning to the general markets, the electrical departments cannot complain that they have been neglected as regards the small amount of orders which the Stock Exchange has received during the second week of the New Year. The dealers still complain that in the supply section they only do one bargain a day, but this is more or less a figure of speech, one too well known in the House to excite anything more than a laugh.

The easier tendency of the Money Market, which we anticipated would become apparent as soon as the Old Year had been fairly dismissed, is now the principal bull point in the markets. A growing feeling that the Bank rate cannot for long be maintained at 6 per cent. is a source of considerable strength. Indeed, without this possibility of a reduction in the official minimum it is not unlikely that a general fall would have taken place again this week. The outlook for the British arms in the Transvaal is regarded in the Stock Exchange with unmixed anxiety, nor was the success achieved by General White last Saturday sufficient to entirely remove the bad impression created by the progress of the war up to the present. With the war horizon so clouded, it is not likely that capitalists, large or small, will come forward to support investments which they know perfectly well are at the mercy of events in the Transvaal.

Among the securities which in our last week's article in this column we alluded to as being worthy of attention at the present time of depression was Eastern Telegraph Ordinary stock. A rise of 1 per cent. has been registered on the week, and several investment orders have come into the market during the last few days. Various reports have been circulated with regard to stoppages on one or other of the company's lines to South Africa, but we fancy that these delays are caused as much by the censor as the elements. Notwithstanding this, the Eastern Company is doing excellent business, and its twin sister, the "China" Company, is sharing its prosperity to a great extent. Some decline has taken place in Anglo-American Telegraph descriptions, both the "A" and "B" stocks having suffered in consequence of the various shake-outs in the American railway market. Commercial Cable 4 per cent. Debenture stock has slightly improved. Great Northern, of Copenhagen, now quoted *ex* coupon, has shed a point.

Turning to the electrical supply division, the changes that have occurred are chiefly in the downward direction, occasioned by sales of small parcels of shares in a market by no means anxious to have more stock on its books until it shall have worked off some of that which is already there. City of London Preference were marked down 10s. on the mere appearance of a possible seller. Metropolitans have risen to the same extent, the company's supporters professing to view the Marylebone situation with satisfaction. St. James's and Pall Mall have dropped a point, and South London Electricity now figures in the list with a quotation 5s. wider than it was last week; in other words, a loss of ⅛th. There is a quiet demand for Westminsters on behalf of those who state that the company's dividend next month will be better than that of the corresponding period in 1899. Brompton and Kensington Ordinary have eased off, but there is no change to report in the Preference.

Little or nothing has been doing in the railway or traction markets. With reference to the former, people are waiting for the dividends and reports of the companies before operating either way, and in a few weeks' time at most the declarations will be made. British Electric Traction Ordinary are still 15⅛, but the Preference have come into favour, and at 13¼ show a rise of the fraction.

In the miscellaneous list a fall of 5s. has reduced the price of Edison & Swan "A" shares, which have been a heavy market for some time past. India-Rubber and Gutta-Percha shares have declined. Calcutta tramways shares are disappointing the hopes of their holders inasmuch as the price does not improve, although the long-standing quarrel between the company and the Calcutta Corporation is said to be satisfactorily settled. When the South African quarrel becomes the same, these shares should advance in value. The liquidators of the London Tramways Company are proposing to apply to the Court for power to distribute another £2 per share to holders, and to also divide the remaining profits. In the Stock Exchange the general idea is that shareholders should get another £4 or £4 10s. (which would include the proposed distribution) but the dealers will not back their opinion so far as to make a price in the company's shares.

## SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1896. | 1897. | 1898. | Closing Quotation, Jan. 3rd. | Closing Quotation, Jan. 10th. | Business done during week ended Jan. 10th, 1900. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 124,400£ | African Direct Telegraph, 4 % Debs. | 100 | ... | ... | ... | 99 —103 xd | 99 —103 | ... | ... |
| 25,000 | Amazon Telegraph, shares | 10 | ... | ... | ... | 3 — 4 | 3 — 4 | ... | ... |
| 125,000 | Do. do. 5 % Debs., Nos. 1 to 1,250 Red | 100 | ... | ... | ... | 85 — 90 | 85 — 90 | ... | ... |
| 905,560£ | Anglo-American Telegraph | Stock | £2 13s | 3 % | £3 9s | 64 — 67 | 64 — 67 | 64½ | 64 |
| 3,047,220£ | Do. do. 6 % Pref. | Stock | £5 6s | 6 % | 6 % | 114 —116 | 113 —115 | 115½ | 114 |
| 3,047,220£ | Do. do. Deferred... | Stock | ... | ... | 18s. % | 17¼— 17⅝ | 17 — 17½ | 17⅝ | 16 13/16 |
| 205,151 | Brazilian Submarine Telegraph | 10 | 7 % | 7 % | ... | 14 — 14½ | 14¼— 14⅝ | 14 7/16 | 14⅛ |
| 75,000£ | Do. do. 5 % Debs. 2nd series, 1906 | 100 | ... | ... | ... | 106 —109 xd | 106 —109 | ... | ... |
| 44,000 | Chili Telephone, Nos. 1 to 44,000 | 5 | 4 % | 4 % | ... | 2 — 3 | 2 — 3 | ... | ... |
| 10,000,000$ | Commercial Cable | $100 | 8 % | 8 % | 8 % | ... ... | 165 —175 | ... | ... |
| 1,332,523£ | Do. do. Sterling 500 year 4 % Deb. Stock Red. | Stock | ... | ... | ... | 101 —104 xd | 102 —104 | 103½ | 102 |
| 224,850 | Consolidated Telephone Construction and Manufacturing | 10/- | 2 % | 1½% | 1 % | ⅛— ¼ | ⅛— ¼ | ... | ... |
| 16,000 | Cuba Telegraph | 10 | 8 % | 7 % | 8 % | 8⅛— 9⅛ | 8⅛— 9⅛ | ... | ... |
| 6,000 | Do. 10 % Pref. | 10 | 10 % | 10 % | 10 % | 19 — 20 | 19 — 20 | ... | ... |
| 12,931 | Direct Spanish Telegraph | 5 | 4 % | 4 % | ... | 4 — 5 | 4 — 5 | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. | 5 | 10 % | 10 % | ... | 9 — 10 | 9 — 10 | ... | ... |
| 30,000 | Do. do. 4½ % Debs. | 50 | ... | ... | ... | 101—105% xd | 101 —105% | ... | ... |
| 60,710£ | Direct United States Cable | 20 | 3 % | 3½% | 3½% | 11½— 12 | 11½— 12 | 11⅞ | 11⅝ |
| 120,000 | Direct West India Cable, 4½ % Reg. Deb. | 100 | ... | ... | ... | 99 —102 xd | 99 —102 | ... | ... |
| 4,000,000 | Eastern Telegraph, Ord. Stock | Stock | 6½% | 7 % | 7 % | 145 —150 | 148 —153 | 151 | 147½ |
| 1,795,000 | Do. 3½% Pref. Stock | 100 | ... | ... | ... | 96 — 99 | 96 — 99 | 98 | 97 |
| 89,900 | Do. 5 % Debs., repayable August, 1899 | 100 | 5 % | 5 % | ... | ... ... | ... ... | ... | ... |
| 1,432,268£ | Do. 4 % Mort. Deb. Stock Red. | Stock | 4 % | 4 % | ... | 115 —120 | 115 —120 | ... | ... |
| 250,000 | Eastern Extension, Australasia, and China Telegraph | 10 | 7 % | 7 % | 7 % | 14½— 15 | 14½— 15 | 15 | 14⅞ |
| 16,200£ | Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326 | 100 | 5 % | 5 % | ... | 99 —103 xd | 99 —103 | ... | ... |
| 64,400£ | Do. do. Bearer, 1,050—3,975, 4,327—6,400 | 100 | 5 % | 5 % | ... | 100 —103 xd | 100 —103 | ... | ... |
| 320,000£ | Do. 4 % Deb. Stock | Stock | 4 % | 4 % | ... | 116 —121 | 116 —121 | ... | ... |
| 85,100£ | Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | 5 % | ... | ... | ... ... | ... ... | ... | ... |
| 46,500£ | Do. do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | ... | ... | ... ... | ... ... | ... | ... |
| 300,000£ | Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909 | 100 | 4 % | ... | ... | 101 —104 | 101 —104 | ... | ... |
| 200,000£ | Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000 | 25 | 4 % | ... | ... | 101—104% | 101 —104% | ... | ... |
| 180,227 | Globe Telegraph and Trust | 10 | 4½ % | 4½ % | 5⅛ % | 10⅜— 11¼ | 10⅜— 11¼ | 11 | 10 13/16 |
| 180,042 | Do. do. 6 % Pref. | 10 | 6 % | 6 % | 6 % | 14⅜— 15½ | 14⅜— 15½ | 15½ | 14⅞ |
| 150,000 | Great Northern Telegraph, of Copenhagen... | 10 | 10 % | 10 % | ... | 31 — 33 | 30 — 32 | 31⅛ | ... |
| 86,300 | Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red. | 100 | ... | ... | ... | 99 —102 xd | 99 —102 | ... | ... |
| 17,000 | Indo-European Telegraph | 25 | 10 % | 10 % | 10 % | 48 — 52 | 48 — 52 | 51⅜ | ... |
| 100,000£ | London Platino-Brazilian Telegraph, 6 % Debs. | 100 | 6 % | 6 % | ... | 106 —109 | 106 —109 | ... | ... |
| 71,000 | Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 | 1 | ... | ... | ... | ⅛— ¼ | ⅛— ¼ | ... | ... |
| 84,000 | Do. do. 5% Pref., Nos. 1 to 84,000 | 1 | ... | ... | ... | ¾— 1 | ¾— 1 | ... | ... |
| 490,000 | National Telephone, 1 to 490,000 | 5 | 5½% | 6 % | 6 % | 5 — 5¼ | 5 — 5¼ | 5 3/16 | 5⅛ |
| 15,000 | Do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 14 — 15 | 14 — 15 | ... | ... |
| 250,000 | Do. 5 % Non-cum. 3rd Pref., 1 to 250,000 | 5 | 5 % | 5 % | 5 % | 5⅛— 5⅜ | 5⅛— 5⅜ | 5⅜ | 5⅛ |
| 1,329,471£ | Do. 3½ % Deb. Stock Red. | Stock | 3½ % | 3½ % | 3½ % | 98 —100 xd | 98 —100 | 99 | 98 |
| 171,504 | Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid | 1 | 5 % | 5 % | 5 % | ¾— 1 | ¾— 1 | ... | ... |
| 100,000£ | Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 | 100 | 4 % | 4 % | ... | 101 —104 xd | 101 —104 | ... | ... |
| 11,839 | Reuter's | 8 | 5 % | 5 % | ... | 7 — 8 | 7 — 8 | ... | ... |
| 3,381 | Submarine Cables Trust | Cert. | ... | ... | ... | 125 —130 | 125 —130 | ... | ... |
| 58,000 | United River Plate Telephone | 5 | 5 % | 6 % | ... | 4½— 5 xd | 4½— 5 | 4⅞ | ... |
| 151,783£ | Do. do. 5 % Debs. | Stock | ... | .. | ... | 102 —105 xd | 102 —105 | 102½ | ... |
| 200,000£ | West African Telegraph, 5 % Debs. | 100 | 5 % | % | ... | 99 —102 | 99 —102 | ... | ... |
| 30,008 | West Coast of America, Nos. 1—30,000 and 53,001—53,008 | 2½ | ... | ... | ... | ½— 1 | ½— 1 | ... | ... |
| 150,000 | Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel. | 100 | ... | ... | ... | 100 —103 xd | 100 —103 | ... | ... |
| 389,521 | Western and Brazilian Telegraph 4 % Deb. Stock Red. | Stock | ... | ... | ... | 102 —105 xd | 102 —105 | ... | ... |
| 88,321 | West India and Panama Telegraph | 10 | 1 % | ⅝% | ... | ⅞— 1⅛ | ⅞— 1⅛ | ... | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | ... | 9¼— 9⅝ | 9¼— 9⅝ | 9 11/16 | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | ... | 7 — 8 | 7 — 8 | ... | ... |
| 80,000£ | Do. do. do. 5 % Debs., Nos. 1 to 1,800 | 100 | 5 % | 5 % | ... | 104 —107 xd | 104 —107 | ... | ... |
| 158,100£ | Western Union of U.S. Telegraph, 6 % Ster. Bonds | 100 | 6 % | 6 % | ... | 98 —103 | 98 —103 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 19,661 | Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761 | 5 | ... | 4 % | 6 % | 7½— 8½ | 7 — 8 | ... | ... |
| 12,000 | Do. do. 7 % Cum. Pref. | 5 | 7 % | 7 % | ... | 9 — 10 | 9 — 10 | ... | ... |
| 80,000 | Charing Cross and Strand Electricity Supply | 5 | 6 % | 7 % | 8 % | 9½— 10½ | 9½— 10½ | 9⅝ | ... |
| 20,000 | Do. do. do. do. Nos. 30,001—50,000 | 5 | ... | ... | ... | 9½— 10½ | 9½— 10½ | ... | ... |
| 20,000 | Do. do. do. do. 4½ % Cum. Pref. | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | ... | ... |
| 34,000 | *Chelsea Electricity Supply, Ord., | 5 | 5 % | 6 % | 6 % | 7½— 8½ | 7½— 8½ | 8½ | ... |
| 100,000 | Do. do. do. % Deb. Stock Red. | Stock | 4½ % | 4½ % | ... | 109 —111 | 109 —111 | ... | ... |
| 60,000 | City of London Electric Lighting, Ord. 40,001—100,000 | 10 | 7 % | 10 % | 6 % | 10 — 11 | 10 — 11 | ... | ... |
| 40,000 | Do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | 6 % | 13 — 14 | 12½— 13½ | ... | ... |
| 400,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | ... | 122 —127 xd | 122 —127 | 126½ | 125 |
| 40,000 | County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000 | 10 | nil | nil | nil | 10 — 11 | 10 — 11 | 10⅜ | ... |
| 20,000 | Do. do. do. 6 % Pref., 40,001—60,000 | 10 | 6 % | 6 % | 6 % | 13 — 14 | 13 — 14 | 13⅜ | ... |
| 200,000 | Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. | ... | ... | ... | ... | 107 —110 xd | 107 — 110 | ... | ... |
| 26,100 | Edmundsons Elec. Corp., Ord. Shares | 5 | ... | 5 % | 7 % | 4⅜— 5½ | 4⅜— 5½ | ... | ... |
| 110,000 | London Electric Supply Corporation, Limited, Ord. | 3 | ... | ... | ... | 2½— 2⅝ | 2½— 2⅝ | ... | ... |
| 48,050 | Do. do. do. 6 % Pref. | 5 | ... | ... | 6 % | 5½— 6 | 5½— 6 | ... | ... |
| 100,000 | Do. do. do. 4% 1st Mt. Db. Stock Rd. | Stock | ... | ... | ... | 102 —104 | 102 —104 | 101 | ... |
| 62,500 | Metropolitan Electric Supply, 101 to 62,500 | 10 | 5 % | 6 % | 5 % | 13 — 14 | 13½— 14½ | 14⅜ | 14 |
| 22,500 | Do. Nos. 62,501 to 85,000 | 10 | ... | ... | ... | 13 — 14 | 13 — 14 | ... | ... |
| 220,000£ | Do. 4½ % First Mortgage Debenture Stock | ... | 4½% | 4½% | ... | 116 —118 xd | 116 —118 | ... | ... |
| 6,452 | Notting Hill Electric Lighting | 10 | 4 % | 6 % | 6 % | 15½— 16½ | 15½— 16½ | ... | ... |
| 31,980 | St. James's and Pall Mall Electric Light, Ord. | 5 | 10½% | 14½% | 14½% | 15 — 16 | 14 — 15 | ... | ... |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9 — 9½ | 9 — 9½ | 9½ | ... |
| 65,000 | South London Electricity Supply, Ord. | 5 | ... | ... | ... | 4½— 4⅝ | 4 — 4⅛ | ... | ... |
| 79,900 | Westminster Electric Supply, Ord., 101 to 80,000 | 5 | 9 % | 12 % | 12 % | 13½— 14½ | 13½— 14⅜ | 14 | 13¾ |

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid.
‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1896. | 1897. | 1898. | Closing Quotation Jan. 3rd. | Closing Quotation Jan. 10th. | Business done during week ended Jan. 10th, 1900. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 60,000 | Aluminium "A" shares, Nos. 1—60,000 ... ... ... | 1 | 10 % | 10 % | ... | 2⅜— 3¼ | 2⅜— 3¼ | 2 11/16 | ... |
| 90,000 | Do. 4½ % 1st Mort. Deb. Stock Red. ... ... | Stock | ... | ... | ... | 95 —100 | 95 —100 | ... | ... |
| 30,000 | British Electric Traction ... ... ... ... ... | 10 | ... | ... | 6 % | 15 — 16 | 15 — 16 | 15⅝ | ... |
| 30,000 | Do. do. 6 % Cum. Pref. 30,001—60,000 | 10 | ... | ... | ... | 12½— 13 | 12⅜— 13¼ | 13⅛ | 12 15/16 |
| 200,000 | Do. do. 5 % Perpetual Debenture Stock ... | Stock | ... | ... | ... | 125 —128 | 125 —128 | ... | ... |
| 40,000 | British Insulated Wire Ord., Nos. 1 to 40,000 ... ... | 5 | ... | ... | ... | 11½— 12⅛ | 11½— 12⅛ | ... | ... |
| 27,500 | Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ... | 5 | ... | ... | ... | 6¼— 6⅜ | 6¼— 6⅜ | ... | ... |
| 90,000 | Brush Elecl. Engng., Ord., 1 to 90,000 ... ... ... | 3 | nil | 3 % | 5 % | 1⅝— 2 | 1⅝— 2 | ... | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | 4 % | 6 % | 6 % | 2⅛— 2⅜ | 2⅛— 2⅜ | ... | ... |
| 125,000 | Do. do. 4½ % Perp. Deb. Stock ... | Stock | ... | ... | ... | 110 —115 | 110 —115 | ... | ... |
| 50,000 | Do. do. 4½ % 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 102 —105 xd | 102 —105 | ... | ... |
| 20,000 | Callender's Cable Construction shares, Nos. 1—20,000 ... | 5 | 10 % | 12½% | 15 % | 12½— 13½ | 12½— 13¼ | 13⅛ | 12⅝ |
| 20,000 | Do. do. 5 % Cum. Pref. ... ... ... | 5 | ... | ... | ... | 5⅛— 5⅜xd | 5⅛— 5⅜ | 5⅛ | ... |
| 90,000 | Do. do. 4½ % 1st Mort. Deb. Stock Red. | Stock | ... | ... | ... | 110 —115 xd | 110 —115 | 110½ | 110 |
| 213,533 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9⅛— 10 xd | 9⅛— 10 | 9⅛ | 9⅛ |
| 61,033 | Do. do. Pref. half-shares ... ... | 5 | ... | ... | ... | 4⅛— 5 xd | 4⅛— 5 | ... | ... |
| 71,447 | Do. do. Def. do. ... ... ... | 5 | ... | ... | ... | 4½— 5 xd | 4½— 5 | ... | ... |
| 855,000 | City and South London Railway ... ... ... ... | Stock | 1 1/16% | 1¼% | 2½% | 59 — 62 | 59 — 62 | 61 | 60½ |
| 37,000 | Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd. | 10 | ... | ... | ... | 4⅛— 5⅛ | 4⅛— 5⅛ | ... | ... |
| 32,098 | Crompton & Co., Nos. 1 to 32,098 ... ... ... ... | 3 | ... | ... | ... | 3¾— 4 | 3¾— 4 | ... | ... |
| 100,000 | Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red. | ... | ... | ... | ... | 98 —101 xd | 98 —101 | ... | ... |
| 99,261 | Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261 | 5 | 5½% | 6 % | 6 % | 2 — 2⅛ | 1⅞— 2⅛ | 2⅛ | ... |
| 17,139 | Do. do. do. "A" Shares, 01—017,139 | 5 | 5½% | 6 % | 6 % | 3½— 4½ | 3⅛— 4½ | ... | ... |
| 344,023 | Do. do. do. 4 % Deb. Stock Red. ... | 100 | ... | ... | ... | 93 — 95 xd | 93 — 95 | ... | ... |
| 112,100 | Electric Construction, 1 to 112,100 ... ... ... ... | 2 | 5 % | 6 % | 6 % | 1⅞— 2⅛ | 1⅞— 2⅛ | 2 1/16 | 1⅞ |
| 25,000 | Do. do. 7 % Cum. Pref., 1 to 25,000 ... | 2 | 7 % | 7 % | 7 % | 2⅜— 3¼ | 2⅜— 3¼ | ... | ... |
| 140,300 | Do. do. 4% Perp. 1st Mort. Deb. Stock ... | Stock | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 91,196 | Elmore's Patent Copper Depositing, 1 to 70,000 ... ... | 2 | ... | ... | ... | ⅜— ⅝ | ⅜— ⅝ | ... | ... |
| 9,600 | Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | 7 % | 7 % | 10 — 12 | 10 — 12 | ... | ... |
| 30,000 | Henley's (W. T.) Telegraph Works, Ord. ... ... ... | 5 | 10 % | 12 % | 14 % | 12 — 13 | 12 — 13 | 12⅜ | 12 |
| 15,000 | Do. do. do. 4½ % Pref. ... ... | 5 | 7 % | 7 % | 7 % | 5 — 5½ | 5 — 5½ | 5⅜ | 5¼ |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock... | Stock | 4½% | 4½% | ... | 111 —114 | 111 —114 | ... | ... |
| 50,000 | India-Rubber, Gutta-Percha and Telegraph Works ... | 10 | 10 % | 10 % | 10 % | 20½— 21½xd | 20½— 21½ | 21 | 20¼ |
| 800,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 100 —104 | 100 —104 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 2⅞% | 3½% | 3½% | 8½— 8⅝ | 8⅜— 8⅞ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 12¾— 13½ | 13 — 13½ | ... | ... |
| 37,350 | Telegraph Construction and Maintenance ... ... ... | 12 | 15 % | 15 % | 15 % | 34 — 38 | 35 — 39 | 36½ | 35¼ |
| 150,000 | Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ... | 100 | ... | ... | ... | 102 —105 xd | 102 —105 | ... | ... |
| 13,400 | Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ... | 5 | ... | ... | ... | 9 — 10 | 9 — 10 | ... | ... |
| 13,400 | Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000 | 5 | ... | ... | ... | 5½— 6 | 5½— 6 | ... | ... |
| 540,000 | Waterloo and City Railway, Ord. Stock ... ... ... | 100 | ... | ... | 3 % | 101 —104 | 101 —104 | ... | ... |

† Quotations on Liverpool Stock Exchange.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

‡ Unless otherwise stated all shares are fully paid.

## LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, ⅜—1½.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7—7½. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 6 per cent. (November 30th, 1899).

## MARKET QUOTATIONS, Wednesday, January 10th.

| CHEMICALS, &c. | This week. | Last week. | Increase or Decrease. |
|---|---|---|---|
| a Acid, Hydrochloric .. .. per cwt. | 5/- | 5/- | .. |
| a " Nitric .. .. .. per cwt. | 22/- | 22/- | .. |
| a " Oxalic .. .. .. per cwt. | 32/- | 32/- | .. |
| a " Sulphuric .. .. .. per cwt. | 5/6 | 5/6 | .. |
| a Ammoniac, Sal .. .. .. per cwt. | 40/- | 40/- | .. |
| a Ammonia, Muriate (crystal) .. per ton | £29 | £29 | .. |
| a " " .. .. per ton | £27 | £27 | .. |
| a Bleaching powder .. .. per ton | £6 10 | £6 1 | .. |
| a Bisulphide of Carbon .. .. per ton | £15 | £15 | .. |
| a Borax .. .. .. per ton | £16 10 | £16 10 | .. |
| a Benzole (90 %) .. .. .. per gal. | 7/- | 7/- | .. |
| a " (50/90 %) .. .. per gal. | 5/6 | 5/6 | .. |
| a Copper Sulphate .. .. .. per ton | £25 10 | £25 10 | .. |
| a Lead, Nitrate .. .. .. per ton | £25 | £25 | .. |
| a " White Sugar .. .. per ton | £31 | £31 | .. |
| a " Peroxide .. .. .. per ton | £27 10 | £27 10 | .. |
| Methylated Spirit .. .. per gal. | 2/9 | 2/9 | .. |
| Naphtha, Solvent (90 % at 160° C.) .. .. .. .. per gal. | 5/6 | 5/6 | .. |
| a Potash, Bichromate, in casks.. per lb. | 5d. | 5d. | .. |
| a " Caustic (76/80 %) .. per ton | £24 | £24 | .. |
| a " Bisulphate .. .. per ton | £25 | £25 | .. |
| a Shellac .. .. .. .. per cwt. | 68/- | 68/- | .. |
| a Sulphate of Magnesia .. .. per ton | £4 10 | £4 10 | .. |
| a Sulphur, Sublimed Flowers .. per ton | £6 | £6 | .. |
| a " Recovered .. .. per ton | £5 10 | £5 10 | .. |
| a " Lump .. .. .. per ton | £5 | £5 | .. |
| a Soda, Caustic (white 70 %) .. per ton | £7 10 | £7 10 | .. |
| Crystals .. .. .. per ton | £3 | £3 | .. |
| a " Bichromate, casks .. per lb. | 4¼d. | 4¼d. | .. |
| **METALS, &c.** | | | |
| Aluminium Wire, in ton lots .. per ton | £224 | £224 | .. |
| b " Sheet, in ton lots.. per ton | £191 | £191 | .. |
| p Babbitt's metal ingots .. .. per ton | £70 to £125 | £70 to £125 | .. |
| c Brass (rolled metal 2" to 12") basis per lb. | 8d. | 8d. | .. |
| c " Tube (brazed) .. .. per lb. | 10d. | 10d. | .. |
| c " Wire, basis .. .. per lb. | 8½d. | 8½d. | .. |

| METALS, &c. (*continued*). | This week. | Last week. | Inc. or Dec. |
|---|---|---|---|
| f Ebonite Rod .. .. .. per lb. | 8/- | 8/- | .. |
| f " Sheet .. .. .. per lb. | 5/- | 5/- | .. |
| g Copper Bars .. .. .. per ton | £82 | £85 | £3 dec. |
| g " Wire (basis price) .. per lb. | 10½d. | 10½d. | .. |
| g " Sheet .. .. .. per ton | £82 | £85 | £3 dec. |
| g " Rod .. .. .. per ton | £82 | £85 | £3 dec. |
| n German Silver Wire .. .. per lb. | 1/6 | 1/6 | .. |
| h Gutta-percha, fine .. .. per lb. | 7/- | 7/- | .. |
| h India-rubber, Para fine .. per lb. | 4/6½ to 4/7½ | 4/6½ to 4/7½ | .. |
| i Iron, Charcoal Sheets .. .. per ton | £18 | £18 | .. |
| i " Pig (Cleveland warrants) per ton | 66/4 | 64/6 | 1/10 inc. |
| i " Forgings, according to size per ton | From £11 | From £11 | .. |
| i " Scrap, heavy .. .. per ton | 70/- to 72/6 | 70/- to 72/6 | .. |
| i " Wire galvanised No. 8 .. per ton | £14 5 | £14 5 | .. |
| g Lead, English Ingot .. .. per ton | £16 12 6 | £16 12 6 | .. |
| g " " Sheet .. .. per ton | £18 | £18 | .. |
| m Manganin Wire No. 28.. .. per lb. | 8/- | 8/- | .. |
| g Mercury .. .. .. .. per bottle | £9 12 6 | £9 12 6 | .. |
| d Mica (in original cases), small per lb. | 2d. to 8d. | 2d. to 8d. | .. |
| d " " " medium per lb. | 1/9 to 2/9 | 1/9 to 2/9 | .. |
| d " " " large per lb. | 8/6 to 7/6 | 8/6 to 7/6 | .. |
| p Phosphor Bronze, plain castings per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| p rolled bars & rods per lb. | 1/1 to 1/4 | 1/1 to 1/4 | .. |
| p " r'l'd str'p & sheet per lb. | From 1/2½ | From 1/2½ | .. |
| o Platinum .. .. .. .. per oz. | £3 11 | £3 11 | .. |
| p Silicium Bronze Wire .. .. per lb. | 10½d. to 1/ | 10½d. to 1/ | .. |
| i Steel, Magnet, acc'd'g to desc'p'n p. ton | From £15 | to £40 | .. |
| i Steel, Magnet, in bars .. .. | £58 | £58 | .. |
| g Tin, block .. .. .. .. per ton | £116 to £117 nom. | £120 to £121 nom. | dec |
| g " foil .. .. .. .. per lb. | 1/7 | 1/7 | .. |
| n " wire Nos. 1 to 16 .. .. per lb. | 1/8 | 1/8 | .. |
| p White Anti-friction Metals— "White Ant" brand .. per ton | £40 to £70 | £40 to £70 | .. |
| j Yarns, Cotton, Single 10lb. bundles pr lb. | 7½d. | 7½d. | .. |
| j " Best Flax, 6 lea. .. per lb. | 5½d. | 5½d. | .. |
| j " Hemp, 8 ply 10 lbs. .. per lb. | 8½d. | 8½d. | .. |
| j " " Russian, 10 lbs. per lb. | 4½d. | 4½d. | .. |
| j " Jute, 180 lbs. rove .. per ton | £14 | £14 | .. |
| k Zinc, Sheet (Vielle Montagne bnd.) p.t. | £23 9 nett. | £24 5 nett. | 16s. dec. |

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Belling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

## ON THE PROTECTION OF ELECTRIC POWER TRANSMISSIONS FROM LIGHTNING.*

By J. T. MORRIS.

(*Continued from page* 28.)

*The Thury Lightning Arrester.*—M. Thury, as is well known, has designed and perfected, in its practical working, a system of distribution of power over scattered districts by means of a continuous current of constant value; variations in demand of power required being met by varying the voltage. This system of series constant current motors is in use at Genoa, the Val-de-Travers station, near Neuchâtel, and in other places.

At the Val-de-Travers station, the capacity of which is about 900 H.P., a constant current of 65 amperes is maintained in the circuit, which is nearly 22 miles in length. The voltage ranges up to 10,400 volts at full load.

Now, considering that a continuous current arc is more difficult to break than an alternating one of the same voltage, it is by no means extraordinary that it was found difficult to protect these lines from atmospheric discharges. Probably the reason why an alternate current arc is more easy to interrupt is because the current strength passes through zero value, it may be a hundred times

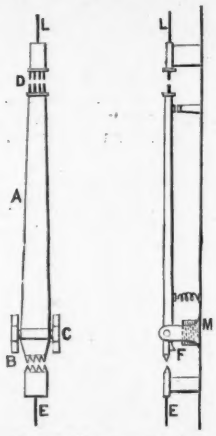



Fig 7.—Thury Lightning Arrester.

each second. By the use of the Thury lightning arrester (fig. 7)† this difficulty has been overcome, as it proves very efficient in its practical working.

This arrester consists of an arm, A, 2 feet in length, made of channel-shaped section, and placed in an upright position, having a pivot, C, near its lower end. This arm is provided with a set of points at each end, those at the upper end consisting of ordinary arc light carbons, D. Opposite the ends of this arm are placed similar sets of points, the upper set being connected to the line, L, whilst the lower set are earthed. Across the lower air gap, B, are placed the coils of an electro-magnet, M. The lightning discharge goes straight to earth by means of the upper spark gap, lever, and lower spark gap. If the current from the line follows, it passes round the coils of the electro-magnet, attracts its armature, F, which is attached to the lever, and so causes the arm to fly out, thereby breaking the arc, after which it returns automatically to its original position.

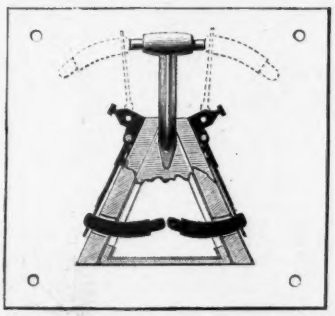


Fig. 8.—"Air-Blast" Lightning Arrester.

2. Arc extinguished by sudden expansion of air actuating a switch. *The air-blast lightning arrester* depends for its action on this principle. A section of it is shown in fig. 8. It consists of a pair of L-shaped pivoted arms, the free ends of which pass quite loosely through two holes in the opposite sides of an inverted keystone-shaped chamber. Short pieces of carbon are fixed in the ends of these levers, one being earthed and the other connected to the line. In the normal position these carbons are separated by a small air gap, but when a discharge passes to earth across the air gap, the moment the line current follows, the arc formed expands the air so suddenly that the arms fly out with great rapidity, thereby breaking the arc and on striking the stops they rebound, and immediately return to their original position, when they are ready again for a fresh discharge.

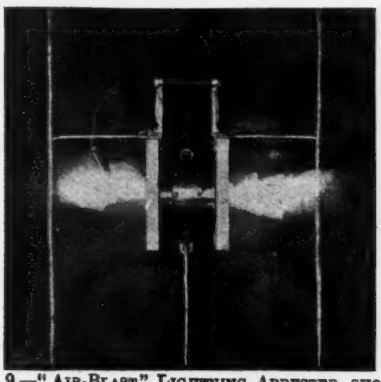


Fig. 9.—"Air-Blast" Lightning Arrester, showing Interruption of Short Circuit.

Fig. 9 is reproduced from a photograph of an arrester of a slightly different type, taken during the interruption of a short circuit. In it the earth plate is connected to a block in the middle of the chamber, and the two levers are connected respectively to the two mains.

This type of arrester has the objection that it contains moving parts, which are liable at times to get out of order; it is used, however, with considerable success on many power circuits in the United States.

3. Arc extinguished by sub-division.

An example which illustrates this principle is found in the Oerlikon condenser lightning arrester (see figs. 10 and 11.) A number of discs of sheet-iron, interleaved with discs of mica of exactly the same diameter, are threaded on to and insulated from a central

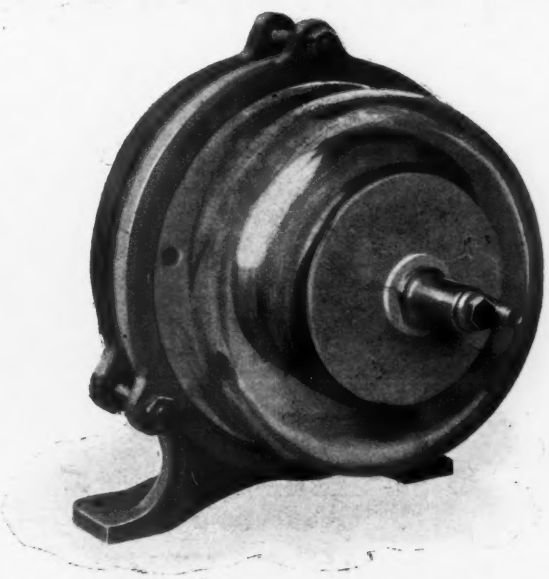


Fig. 10.—Oerlikon Condenser Lightning Arrester.

spindle. These are then fixed in a suitable clamp, the two outer discs being respectively connected as usual, the one to the line, the other to earth. The arrangement acts as a kind of condenser and so tends to facilitate the discharge of the high potential current, which leaps in a series of small sparks from edge to edge of the iron discs, over the edge of each mica disc, and so to earth; but the spark being divided into such a number of minute discharges, the arc which would be maintained by the power current, is practically unable to form. It is probable that part of the action is due to the heat being conducted rapidly away by the metallic discs. By practical experience it has been demonstrated that for the protection of 2,000-volt circuits, 30 iron discs are required, while for circuits of 5,000 volts, 45 are necessary. These arresters can be used either for alternating or continuous currents, and a large number of them are employed. They have this advantage, unlike those previously described, that their action does not depend on the arc being started. They get rid of any excessive potential difference, without affecting the line currents. On the other hand, there is this drawback, that by the time a great number of discharges have passed to earth, some of the plates have beaded together at the edges, and they must then be replaced, else before long the line will be permanently earthed by them.

* Paper read at a students' meeting of the Institution of Civil Engineers, February, 1898. Awarded a "Miller" prize.

† The *Electrician*, September 11th, 1896, p. 632.

This principle of extinguishing the arc by means of sub-division is also applied in the Fynn lightning arrester, in which a number of brass discs are threaded on to a glass rod fixed in a vertical position. This rod has a shoulder at its base. The brass discs, which are well polished and have their peripheries rounded, are separated from contact with one another by glass distance pieces. The glass rod is

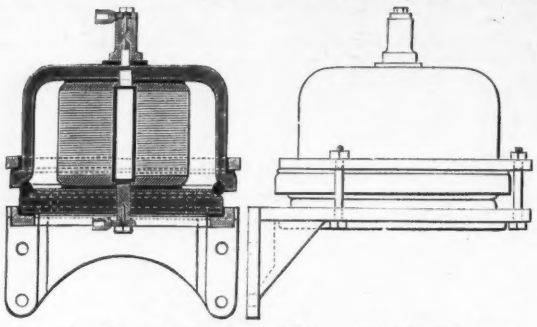


FIG. 11.—OERLIKON CONDENSER LIGHTNING ARRESTER FOR CIRCUITS UP TO 5,000 VOLTS.

supported by its upper end, and the uppermost disc is connected to the line. The lowest disc, which rests on the glass shoulder, is connected to the earth wire.

In its usual working the lightning discharge leaps by a series of small sparks from disc to disc and then to earth; but if an abnormally heavy discharge does occur, and the line current following maintains an arc, then the heat so generated causes the glass rod to break, and the discs and earth connection fall away, and so destroy the arc. The arrester then has to be reset and the parts replaced. It has the advantage that close inspection is unnecessary to discover whether it requires resetting or not.

4. Arc extinguished by contact with mass of metal.

The "Short Gap" or "Wirt" lightning arrester is the chief example of this type. One of these, designed for a 1,000-volt alternate current circuit, is shown in fig. 12.

It consists of a block of marble, upon which are mounted two solid cylinders of metal, with an air gap between them of $\frac{1}{32}$ inch. The upper of these two is connected to the line.

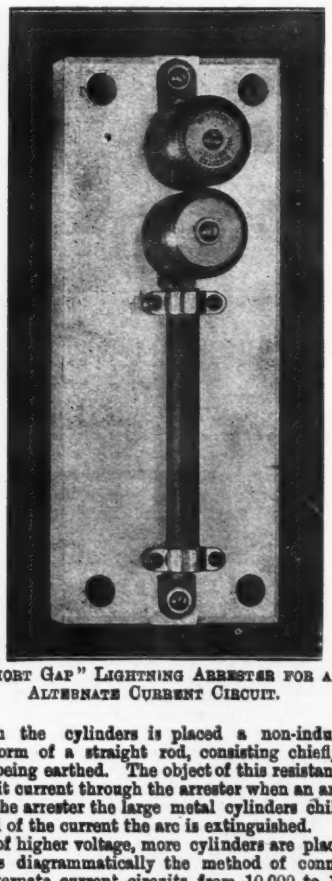


FIG. 12.—"SHORT GAP" LIGHTNING ARRESTER FOR A 1,000-VOLT ALTERNATE CURRENT CIRCUIT.

In series with the cylinders is placed a non-inductive resistance, in the form of a straight rod, consisting chiefly of carbon, the lower end being earthed. The object of this resistance is to limit the short circuit current through the arrester when an arc starts. In the action of the arrester the large metal cylinders chill the arc, so that on reversal of the current the arc is extinguished.

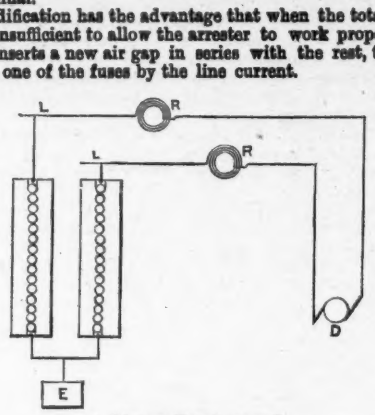
For circuits of higher voltage, more cylinders are placed in series. Fig. 13 shows diagrammatically the method of connecting these arresters for alternate current circuits from 10,000 to 13,000 volts, from which it will be seen that a row of 40 cylinders in series is used, each cylinder being separated from its neighbour by an air gap of $\frac{1}{32}$ inch. The spark gaps between the cylinders should be occasionally inspected to make certain that the original spaces of $\frac{1}{32}$ inch have not been reduced either by heavy discharges or by dust.

The cylinders are each supported by a metal rod through the centre, and can be turned to present a fresh surface to each other by adjustment of the screw which holds the cylinder in position.

These arresters are in use on the previously mentioned Niagara-Buffalo transmission, and are now being used extensively in transmissions where high voltages are employed.

In a yet more recent pattern each of the half dozen cylinders at the earth end of the arrester are separately connected by fuses to the earth terminal.

This modification has the advantage that when the total length of air gap is insufficient to allow the arrester to work properly it automatically inserts a new air gap in series with the rest, through the blowing of one of the fuses by the line current.




L, Line; R, Reactance coil.

FIG. 13.—DIAGRAM OF CONNECTIONS FOR "SHORT GAP" LIGHTNING ARRESTER.

This form of the arrester would therefore require less frequent inspection than the pattern first described.

5. Arc extinguished by tendency of heated air to rise, combined with action of current in conductor on arc.

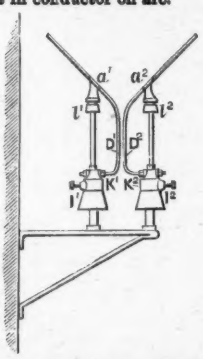



FIG. 14.—SIEMENS LIGHTNING ARRESTER.*

*Siemens Lightning Arrester.*—This form of arrester, represented in figs. 14 and 15, consists of two wires or rods, $D^1$ $D^2$, fig. 14, of copper or other suitable material, of curved form, which are carried by insulators, $l^1$ $l^2$. The lower ends of the rods are fixed in metal caps,

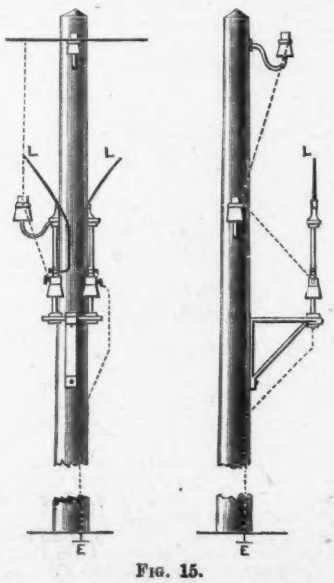



FIG. 15.

$K^1$ $K^2$, and can be adjusted in a horizontal direction, so that the distance between the nearly parallel vertical portions, $D^1$ $D^2$, can be set so as to be a little greater than the sparking distance of the line pressure used; the upper parts of the rods then slope away from each

* From Patent Specification No. 2,106, 1896, Fig. 3.

other, the extreme upper ends being from 15 to 30 inches apart. $K^1$ is connected to the line to be protected, while $K^2$ is put to earth. When a lightning discharge passes to earth through the arrester, the line current following starts an arc between $D^1$ and $D^2$, which travels upwards between the parallel and diverging portions, increasing its length in so doing, until the voltage of the circuit is no longer able to maintain the arc, which then breaks. This motion of the arc is due in great part to the upward rush of heated air produced by the heat of the arc, which carries the arc upwards; and in a lesser degree to the electro-dynamic action of the current in the rods, on the current in the arc.

These arresters are in use in many stations on the Continent, and they possess the advantages of having no moving parts and being extremely simple. At the same time, in some cases, they are rather slow in extinguishing the arc, which generally means that the machinery in the power house will be heavily over-loaded, although they may be depended upon in the end to extinguish the arc.

*(To be continued.)*

## COST OF POWER FOR ELECTRIC RAILWAYS.

We reprint from the *Street Railway Review*, of Chicago, the following interesting table showing the cost of power for electric railways, the output being measured by watt-hour-meter in each case:—

| Station. | Month, 1899. | Monthly output, kw.-hours. | Cost of electrical output per kw.-hour—Cents. Fuel. | Labour. | Supplies, oil, waste, &c. | Water. | Repairs. | Total. | Gallons cylinder oil per 10,000 kw.-hour. | Gallons lubricating oil per 10,000 kw.-hour. | Lbs. water per lb. coal. | Lbs. fuel per kw.-hour. | Price of fuel per ton of 2,000 lbs. | Kind of fuel. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. ... ... ... | July | 1,433,006 | .271 | .169 | .031 | 032 | 026 | .529 | 3 99 | 1 09 | 11·77 | 2 51 | $2.16 | Bituminous |
| 1. ... ... .. | Aug. | 1,410,678 | .263 | .175 | .042 | 032 | .039 | .551 | 4 07 | ... | 11·88 | 2 51 | 2 10 | " |
| 5. Metropolitan Elevated, Chicago. | July | 1,377,600 | .380 | .181 | .031 | 031 | .030 | .653 | 5·00 | 1 47<br>3 92 | 7·49 | 4·53 | 1 68 | " |
| 5. Do. do. | Aug. | 1,363,511 | .375 | .190 | .029 | .030 | .035 | .659 | 4 00 | 4 05 | ... | 4 43 | 1 69 | " |
| 6. ... ... ... | July | 611·090 | .579 | .237 | .034 | ... | 285 | 1.135 | ... | ... | ... | 2·41 | .7024‖ | Oil |
| 6. ... ... ... | Aug. | 588,952 | .590 | .250 | .051 | ... | .255 | 1.146 | ... | ... | ... | 2 40 | .7575‖ | " |
| 8. ... ... ... | July | 806,814 | .607 | .261 | .018 | .052 | 010 | .948 | ... | ... | ... | ... | ... | Bituminous |
| 8. ... ... ... | Aug. | 856,723 | .612 | .240 | .023 | .050 | 014 | .938 | ... | ... | ... | .. | ... | " |
| 9. ... ... .. | July | 670·135 | .429 | .194 | .017 | .036 | .003 | .680 | ... | ... | ... | ... | ... | " |
| 9. ... ... ... | Aug. | 656,225 | .458 | .202 | .023 | .035 | 011 | .730 | ... | ... | ... | ... | ... | " |
| 10. ... ... ... | July | 454,914 | 252 | .122 | .006 | 011 | 019†<br>.006‡ | .419* | 1 77 | 2 22 | ... | 4 14 | 1 14 | " |
| 10. ... ... ... | Aug. | 454,122 | 319 | .125 | 006 | .0'9 | .015†<br>.005‡ | .480§ | 1·9 | 2·2 | ... | 5·82 | 1 10 | " |

* Miscellaneous, .004. † Engines. ‡ Generators. § Miscellaneous, .001. ‖ Cost of oil per barrel.

## DISCREPANCY BETWEEN COMMERCIAL AND EXPERIMENTAL RESULTS IN BOILER TESTS.

The following is a reprint of Appendix 25 to the Proposed Revised Code for Boiler Tests (American Society of Mechanical Engineers) by Dr. Charles E. Emery.

"The final result sought by manufacturers in initiating tests of steam or other machinery in actual use is the value of the work done measured in dollars and cents. In some cases the broad question is raised as to the saving that may be accomplished by installing improved boilers, engines, or other machinery; but more generally it is desired to ascertain what can be done to produce saving with the apparatus already in place under the actual conditions that prevail at the particular location. In both these cases it is necessary to ascertain the average cost of the work done commercially previous to the test. Frequently, in fact, generally, this important fact will not be ascertained by an elaborate trial, for the reason that everything will be put in order for the test, and all details of the trial be conducted so carefully that the losses due to average carelessness or want of skill in the past will be eliminated, the engineer making the test will not receive proper credit, and the owners, on seeing the report, may conclude that they are already doing very well, and perhaps continue old methods with fancied security. If the cost of the output of the factory for a given time were ascertained in terms of the coal burned during the same time, and compared with the corresponding cost for the time of the trial, the latter would frequently be found to be one-eighth to one-third less than the former, and it might not be possible to tell what had caused the difference—for instance, whether it was due to putting in order the machinery prior to the tests, to greater care exercised by the fireman under the spur of careful watching, or whether, as is usually claimed, the coal was different, &c. The losses are generally due in the main to the carelessness of the firemen. It follows, therefore, that the cost of the power under average conditions must be obtained in some quiet way preliminarily. Frequently the comparison of the output of the factory with the coal burned will not be sufficiently accurate, and it will be necessary to devise some corresponding check which will not interfere with the regular routine of the establishment. The work of the boilers may be checked by arranging a meter so as to continuously measure the feed water; and its record, compared with the total weight of coal purchased, will frequently give the check desired. Such a check becomes more difficult when it is desirable to ascertain the performances of particular boilers, and the coal supply is common to all boilers; but by assigning particular weighed carloads of coal to the particular boilers, without any intimation to the firemen that they are being watched, it may be possible to ascertain the average performance of the boilers used for the particular purpose. Preliminary experiments of this kind, conducted without notice to employés, and continued through a long period, will furnish a basis for comparison with elaborate tests, and it will then be possible to point out clearly where the several losses have taken place, and the testing engineer will get the credit for the saving shown."

## AN AMERICAN PACIFIC CABLE.*

By GEORGE OWEN SQUIER.

It is interesting to note that the idea of a trans-Pacific submarine cable was first discussed and considered by the late Cyrus W. Field nearly 30 years ago. The scheme of Mr. Field and his associates involved a route from California *vid* Alaska and the Aleutian Islands to Japan. Since that date, the subject in some form has been almost constantly before this country and Great Britain. This question has been discussed in the 52nd, 54th and 55th Congresses, in each of which effort was made looking towards laying a cable at least as far as the Hawaiian Islands.

In a special message to Congress, dated February 10th, 1899, the President says:—

> As a consequence of the ratification of the treaty of peace between the United States and Spain, and its expected ratification by the Spanish Government, the United States will come into possession of the Philippine Islands, on the farther shore of the Pacific. The Hawaiian Islands and Guam becoming United States territory, and forming convenient stopping places on the way across the sea, the necessity for speedy cable communication between the United States and all these Pacific islands has become imperative. Such communication should be established in such a way as to be wholly under the control of the United States, whether in time of peace or of war. At present the Philippines can be reached only by cables which pass through many foreign countries, and the Hawaiian Islands and Guam can only be communicated with by steamers, involving delays in each instance of at least a week. The present condition should not be allowed to continue for a moment longer than is absolutely necessary.

The idea of a British Pacific cable, connecting the Dominion of Canada with the Australasian colonies, almost from the first has been discussed from a national standpoint. Her Majesty's Government and the colonial governments most concerned, have been urged from time to time to consider the matter in its strategic and commercial aspects. Two colonial conferences, in 1887 and 1894, were largely occupied with this subject, as evidenced by the exhaustive blue books which record their proceedings. The Dominion Government took the matter up in 1893-4, and invited the most reputable firms in the world to submit estimates for construction and laying.

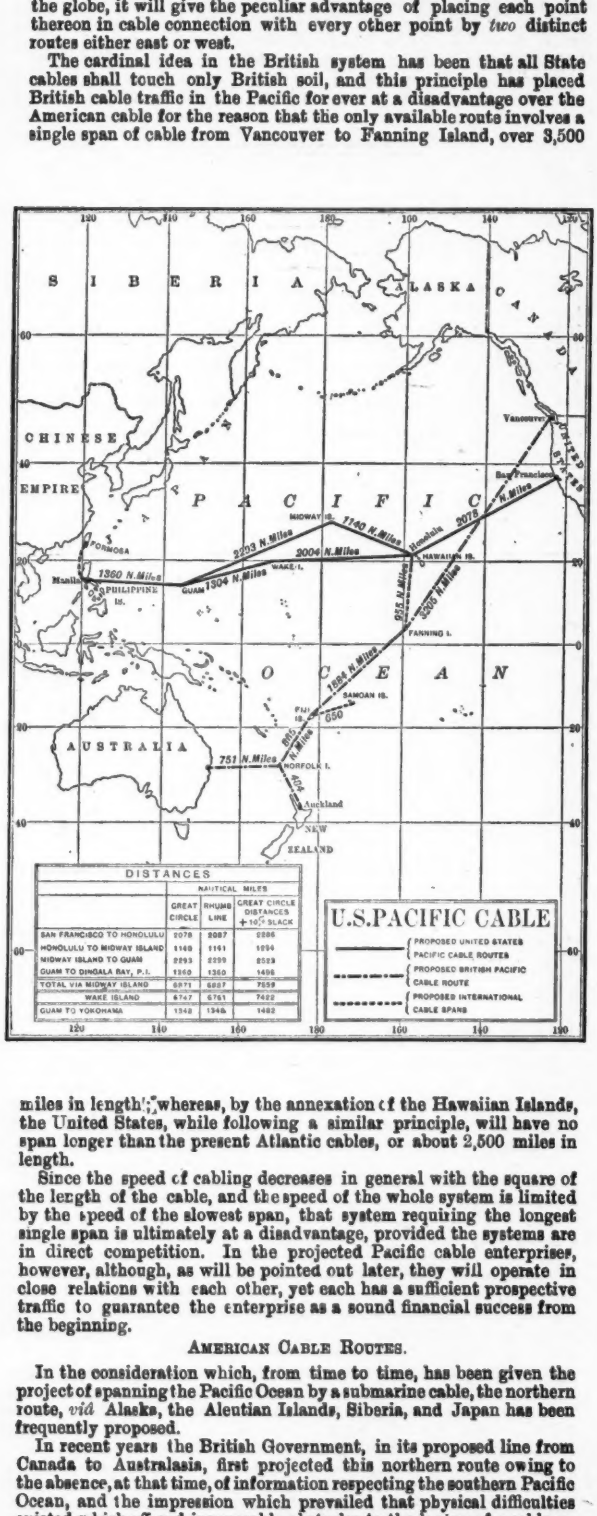
In 1896, Mr. Chamberlain, Secretary of State for the Colonies, appointed a Pacific Cable Commission, which included among its members the Under Secretary of State for the Colonies, the High Commissioner of Canada and the Agents-General for New South Wales and Victoria. This committee went into the whole subject of the practicability, cost, probable revenue, and management of the proposed enterprise and elicited a fund of technical, commercial, and professional information upon cable manufacture and cable laying in general, and upon this important project in particular, which is invaluable, and which probably could not have been obtained in any other manner. At this moment a Pacific cable touching only soil belonging to Great Britain is assured, both Canada and Australasia recently having been reported as joining with England in pledging themselves to the enterprise as a Government undertaking.

* A paper presented at the 138th meeting of the American Institute of Electrical Engineers, New York and Chicago, December 27th, 1899. [We are indebted to Mr. R. W. Pope, the secretary of the Institute for proofs of this paper.—Eds. Elec. Rev.]

The proposed route with surface distances involved, is shown on the accompanying map, and is from Vancouver to Fanning Island, thence to the Fiji Islands, thence to Norfolk Island, and from there bifurcating to New Zealand and Queensland.

Since a Pacific cable will at last complete the telegraphic circuit of the globe, it will give the peculiar advantage of placing each point thereon in cable connection with every other point by *two* distinct routes either east or west.

The cardinal idea in the British system has been that all State cables shall touch only British soil, and this principle has placed British cable traffic in the Pacific for ever at a disadvantage over the American cable for the reason that the only available route involves a single span of cable from Vancouver to Fanning Island, over 3,500




miles in length; whereas, by the annexation of the Hawaiian Islands, the United States, while following a similar principle, will have no span longer than the present Atlantic cables, or about 2,500 miles in length.

Since the speed of cabling decreases in general with the square of the length of the cable, and the speed of the whole system is limited by the speed of the slowest span, that system requiring the longest single span is ultimately at a disadvantage, provided the systems are in direct competition. In the projected Pacific cable enterprises, however, although, as will be pointed out later, they will operate in close relations with each other, yet each has a sufficient prospective traffic to guarantee the enterprise as a sound financial success from the beginning.

### American Cable Routes.

In the consideration which, from time to time, has been given the project of spanning the Pacific Ocean by a submarine cable, the northern route, *viâ* Alaska, the Aleutian Islands, Siberia, and Japan has been frequently proposed.

In recent years the British Government, in its proposed line from Canada to Australasia, first projected this northern route owing to the absence, at that time, of information respecting the southern Pacific Ocean, and the impression which prevailed that physical difficulties existed which offered insuperable obstacles to the laying of a cable on a direct route between Canada and Australasia. In consequence of this impression it was designed to lay the cable from Vancouver to Japan, touching at islands in the Aleutian and Kurile groups as mid-ocean stations. From Japan the connection with Australasia would have been obtained *viâ* Singapore and the Eastern Extension Company's lines of telegraph. Through the intervention of the Government, negotiations were opened with the view of securing one of the Kurile Islands. Japan was asked to transfer to the British Crown one of these islands in order that the telegraph station should be under British protection, and an agent was sent to Washington, who, after some difficulty, obtained conditional landing privileges on one of the Aleutian Islands.

Recently there has been a revival of interest in this route, especially now that the growing commercial interests of Alaska are becoming important. The plan proposes starting from Cape Flattery, thence to Sitka—distance (approximate) 803 miles thence to Kadiak Island, 682 miles; thence to Dutch Harbour, 770 miles; thence to Attu, 810 miles; thence to the Japan-Russian border, 858 miles; thence to the Japanese landlines, 810 miles; from the Siberian border to the Siberian lines, 617 miles; and from Formosa to Luzon, 200 miles; in all 5,550 nautical miles, exclusive of the Japanese system.

It will be noticed that this series of cables aggregating 5,550 miles makes no provision for American communication with the Philippines, except over the Japanese landlines from the north point of Japan to the south point of Formosa, a distance through a foreign territory of about 1,200 miles. Owing to the uncertainty of the Japanese landlines, which are frequently interrupted during the typhoon season, particularly in Formosa, it would be necessary, in order to ensure communication, to extend the Japanese cable system. Again, the Great Northern Telegraph Company, a Danish corporation, has exclusive rights, not only on the Siberian coast but also between Japan and the Asiatic coast.

Apart from establishing telegraphic communication *free from foreign control* between the United States, the Hawaii Islands, the Philippines and the island of Guam, the mission of an American Pacific cable should be to bring about a general reduction of cable rates.

On the Alaskan route a large number of intermediate stations must be established and maintained; and there must be a division of receipts with Japan. A message *viâ* Honolulu, and intermediate island station and Guam, would reach Luzon by four cable transmissions. The Alaskan route as proposed would necessitate about 15 separate stations, of which nearly one-half would be under Japanese control.

Undoubtedly an Alaskan cable will soon be required, and apparently also the extension of such a cable system as a means of attaining a through line to the Philippine Islands is an attractive plan. This plan, however, leaves the United States in practically the same unsatisfactory position she is in at present in respect to communication with her Pacific possessions, and until definite and perpetual concessions are forthcoming, can furnish even no guaranty of substantial reduction from the present high rates.

It is believed that no one studying the true present and future interests of the United States can come to any other conclusion relative to an American Pacific cable, than the one so admirably expressed by the President in his special message to Congress, viz, that this cable shall be "wholly under control of the United States."

This cardinal idea—the principle also adopted by Great Britain, after years of exhaustive consideration—at once excludes the northern route for the present, and limits the route to American territory.

### Practicability.

There is no longer any doubt as to the practicability of the Pacific cable project from a technical and engineering point of view. A preliminary survey between the coast of California and the Hawaiian Islands was completed by the Navy department in 1892,* showing the entire practicability of this part of the route. Between California and the Hawaiian Islands several approximately parallel routes are practicable, but the one which seems to be favoured by the survey of 1892, as shown in the report of the Hydrographic office of the Bureau of Navigation, is a rhumb-line between Monterey Bay and Honolulu on Oahu Island. The U.S. S. *Nero*, under command of Commander Charles Belknap, U.S.N., has been engaged since April last in a survey of the bed of the Pacific along the proposed route of the cable from the Hawaiian Islands westward to the Philippine Islands and to Japan. A preliminary report of this survey recently received, adds greatly to the knowledge of this part of the Pacific, and to the data necessary before determining the exact route of the cable. This survey develops two unusual physical features along the route *viâ* Midway Island; one of these is a submarine mountain, situated a short distance westward of the Midway Islands, and rising from the floor of the ocean, having a depth of 2,200 fathoms to within 82 fathoms of the surface. The second feature is one of the deepest submarine abysses yet found in the world, situated about 500 miles eastward of Guam, and more than 4,900 fathoms in depth. These and other obstacles which may be found, however, can be avoided in laying the cable by making suitable detours around them as is ordinarily done.

### A Mid-Ocean Island Cable Station.

The great decrease in speed, and increase of cost subsequent upon increase of length of a single span of the cable, requires a landing station, if possible, between the Hawaiian Islands and Guam. The longest cable yet laid and in operation is the French cable from Brest, France, to Cape Cod, Mass., which is about 3,250 nautical miles in length, and there is no question that a cable directly connecting Honolulu and Guam could be successfully laid, if no practicable landing place between these points could be obtained. This single span, however, about 3,650 nautical miles, including "slack," would for all time so reduce the through speed of the cable, and so increase the original cost, as to warrant unusual expense, if necessary, in preparing and maintaining an intermediate station. In this connection the large amount of technical evidence given before the British Pacific Cable Committee relative to the Vancouver-Fanning Island span, which is practically the same extreme length of 3,600 nautical miles, and of the utilisation of Fanning Island as a station, are valuable as showing entire practicability. Although both Wake and Midway

* See Senate Document, 153.

Islands, which have been proposed as stations, are low atolls, rising but a few feet above high water and with little to sustain human life, yet either of these places is equal, if not superior, to Fanning Island. Further careful surveys will be necessary before the exact route west from the Hawaiian Islands to Guam can be finally determined. Fortunately for this enterprise, the annexation of the Hawaiian group brings under the sovereignty of the United States 11 or 12 small, rocky or sandy islands extending to the north-westward about 1,800 miles from Honolulu. These must be surveyed and considered from the cable standpoint before a final selection of route can be made.

The distances in nautical miles along two provisional routes, including 10 per cent. for "slack" in laying, are as follows:—

| | |
|---|---|
| San Francisco to Honolulu ... ... ... | 2,286 miles. |
| Honolulu to Midway Island ... ... ... | 1,254 " |
| Midway Island to Guam ... ... ... | 2,523 " |
| Guam to Dingala Bay, P.I. ... ... ... | 1,496 " |
| Total *viâ* Midway Island ... | 7,559 " |
| San Francisco to Honolulu ... ... ... | 2,286 miles. |
| Honolulu to Wake Island ... ... ... | 2,205 " |
| Wake Island to Guam ... ... ... ... | 1,435 " |
| Guam to Dingala Bay, P.I. ... ... ... | 1,495 " |
| Total *viâ* Wake Island ... | 7,422 " |

In Appendix I. are shown the great circle and rhumb line distances involved, and the geographical positions used.

### COST, MAINTENANCE AND OPERATION.

The cost of laying cable depends mainly upon the materials used in its construction, and therefore fluctuates with prices current. The outer coverings are much the same in all specifications, according to the conditions of the case, but the copper conductor and the gutta-percha insulation vary with the speed required over the cable. Since the length of the longest section of the proposed Pacific cable is approximately equal to each of several of the Atlantic cables, the type of the cable to be used for this section and the speed obtainable are subject to a close estimation.

Of the 11 cables spanning the north Atlantic, the Anglo-American Company's cable laid in 1894 and the Commercial Cable Company's cable, No. 3, laid also in 1894, have the greatest speeds. The former contains 650 lbs. of copper and 400 lbs. of gutta-percha, and the latter 500 lbs. copper and 320 lbs. gutta-percha per nautical mile. Either of these types of cable would give good results, and no cables of less equivalent speed should be considered.

The following conservative estimate is made from the evidence obtainable relative to the establishment of this enterprise by the Government on a sound and financial basis:—

### MAINTENANCE AND REPAIR PER ANNUM.

| | |
|---|---|
| Annual expenses of two cable repair ships ... | $200,000 |
| Annual expense for new cable, assuming entire cable to be replaced in 40 years, or 200 miles per year ... ... ... ... ... ... | 200,000 |
| Working expenses ... ... ... ... ... | 125,000 |
| Reserve fund and interest on capital ... ... | 400,000 |
| Total net earnings of cable required ... ... | $925,000 |

This provision for laying 200 miles of new cable per year should perpetually maintain the value of the cable as an asset, and the reserve fund further provides that the entire capital shall be replaced at the end of 50 years, or what is equivalent, that a sinking fund shall be established, which, at the end of 50 years, will be sufficient to lay an entire new cable in addition to the permanent maintenance of the original one, so that at the end of 50 years two working cables will be provided for.

Taking average conditions for long cables 10 years ago, the annual expenses for maintenance and repair, *e.g.*, for new cable required, &c., and not including the fixed expenses, such as the repair ships, were about $30 per nautical mile. The great advancement in cable manufacture since has reduced the average repair rate materially, but assuming this rate as it then averaged, the total charge to this item is practically the same as that given by the independent supposition above.

At present there is no first-class cable ship in the world flying the American flag and which would therefore be under the control of the United States in time of war. It should be the policy of the United States, whether the Pacific cable is laid by the Government or by a subsidised company, to require that two complete cable repair ships, one, at least, also capable of laying long cables, equal to any yet constructed for these purposes, and flying the American flag, be stationed in the Pacific Ocean.

### SPEED.

The "speed" of a cable is a somewhat loose expression and depends upon the voltage used, the particular apparatus employed in working the cable, as well as the design and construction of the cable itself, and the skill of the operators. Besides, there is a considerable margin between a speed which will do for press matter in ordinary plain language, and the speed permitted for code and cipher messages.

"Speed" expressed in words per minute is misleading, since five letter words are frequently taken as the basis, whereas in actual practice a telegraphic word averages about eight letters, the increase being due to code words, and the omission of many conjunctions and prepositions when messages are sent in clear. A better method of expressing speed in cabling is in standard letters of a certain number of signals each, transmitted per minute, so that experienced operators can certainly and easily read them. The practical speed is the proportion of the maximum speed which remains after deductions are made for the words transmitted for which no revenue is received, on account of service prefixes, &c., repetitions, errors, corrections, necessary interval between messages, administrative messages connected with traffic, &c. In determining the deductions from the maximum speed to obtain the practical speed in paying words per minute there is little evidence at hand. In the perfected management of the Atlantic cables where keen competition exists, this "dead" traffic has been reduced to 16 or 17 per cent. of the whole. For a Pacific cable an amount of "dead" traffic as great as 30 per cent. at first is estimated, and this could probably be reduced in successive years as it has been in the Atlantic traffic. Assuming 30 per cent. for "dead" traffic, and an increase of 90 per cent. of speed for duplex working, it is estimated that the maximum capacity of the cable in total paying code words, of eight letters each, would be about 11,800,000 per annum. The cost of maintenance and operation, &c., as above being $925,000 per annum, the average cost of transmission per telegraphic word is about ·08 cents.

In connection with speed of cabling, it may be said that the opinions of the best cable experts in the world as to the theoretical speed obtainable from a given cable over a given distance differ so widely as to inspire caution in making all estimates.

The present commercial rate from Washington to Manila is $2.38 per word, Government rate $2.255 per word, and the rate for "right-of-way" messages three times the normal rate.

It is seen that at the present commercial rate to Manila, after allowing for present land rates to San Francisco, the proposed cable is required to operate less than 50 minutes per day in order to earn the income of $925,000.00 per year. Allowing the present rate to be reduced one-half, the cable would have to work less than two hours daily. If the rate per code word, of an average of eight letters, is placed at 50 cents from San Francisco to Manila, then, upon the above supposition, the cable need operate daily less than four hours to meet expenses.

Assuming the cable to be interrupted as much as one-quarter of the entire time, the figures above still appear striking.

The desirability of the cable from an economic standpoint seems unquestioned. The Secretary of War says in his annual report:—

"The cable tolls of the War Department messages alone to and from the Philippines for the last five months have averaged monthly a rate of over $325,000.00 a year."

This alone equals the interest at 3 per cent. on the sum of $10,845,000. It is reasonable to assume that the despatches of the other departments of the Government would at least increase this amount by one-quarter, which would make the present Government cable tolls to and from the Philippines equal to the interest at 3 per cent. on approximately $13,500,000. Fully 90 per cent. of this sum goes to foreign corporations while all Pacific cable expenditures would remain in the United States.

In an ocean cable enterprise the largest item of annual expense is invariably the interest on the capital invested. No one can borrow money at a less rate than the United States Government, and furthermore, as a Government enterprise, the cable is at once relieved from earning any sums for dividends, and is only required to maintain itself in a prudent and sound financial condition.

*(To be continued.)*

## A SUCCESSFUL PASSENGER AND FREIGHT INTERURBAN RAILWAY.

THE constantly growing interest in the transportation of miscellaneous freight on electric lines makes a study of the Chicago, Harvard and Geneva Lake Railway Company a timely and instructive one.

In view of the great future which we believe there is before electric transportation in England we think that a description of the undertaking is worth recording. We are indebted to the columns of our contemporary the *Street Railway Review*, of America, for the illustrations as well as for the descriptive matter.

This road, which was completed during the past summer, extends from Harvard, Ill., to the shores of Lake Geneva, in Wisconsin, passing through the towns of Big Foot, Ill., Walworth and Fontana, Wis. It not only makes a short cut to this popular resort, saving from 30 to 90 miles travel each way for some 200,000 people residing in the large manufacturing towns to the west and north-west, but is the only means of rail transportation for the territory through which it passes, the nearest steam line being some eight miles distant, and quite inaccessible on account of high and very steep hills.

Lake Geneva is conceded to be one of the most beautiful bodies of water in the whole country, being entirely spring fed, and the water, which is very clear, reaching a depth of 300 feet in places. Along its 37 miles of wooded shores extends a fine gravel beach, and here the wealthy residents of Chicago have expended over $10,000,000 in elegant mansions and park improvements. During the summer season the lake is thronged by thousands to enjoy the clear bracing air for which this region is famous; and its blue waters are covered with sailing craft of every kind, and some 40 superb steam yachts. The Yerkes Observatory is also here and is an object of interest to hundreds of visitors from our own country and abroad.

The country traversed by the electric line is densely settled for a farming community, and is one of the largest dairy districts in the country. Every foot of the land is under cultivation or in use for herds, and farms sell for $100 an acre. From this territory thousands of pounds of butter and cheese are shipped daily, and thousands more

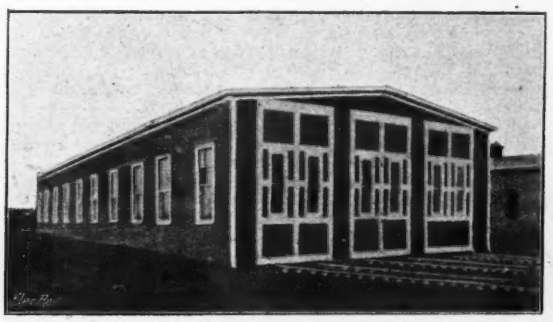
of milk are sent into Chicago. The country is like one great garden, and to travel over it in summer presents a picture of rare beauty.

The road has conditions in some respects unlike any yet constructed. Most interurbans either connect two large towns or cities, or terminate in one of considerable size. In this case the largest town on the line has but 3,500 population and the combined population of the others and the local residents within walking distance of the line does not exceed 6,000 more. As the road is operated throughout the year, the freight problem as a feature of the winter business is an important one.

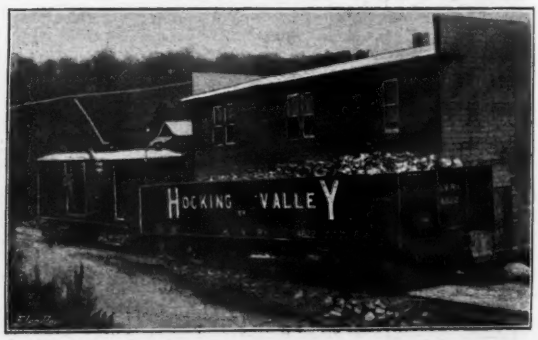
Power House.

The line, which is 12 miles in length, occupies one side of the public highway except for about one mile of private right of way. It is built under highly favourable franchise conditions, and its grants run for the full term of 50 years in both states, the portion in Illinois having been constructed under the Allen law, now repealed. It is incorporated under the general railroad acts of both states, and its franchises particularly authorise it to carry not only passengers, mail and express, but all kinds of freight. This latter feature is rapidly becoming an important one, not only to the road, but to the community it serves. Piece freight includes dressed veal, eggs, spring water, milk, vegetables, and other farm products going out. An elevator has been erected and is shipping out grain from Fontana. Track connection with an important steam line enables it to receive heavy freight, such as lumber, coal, &c., in the original cars, and these are hauled to destination. One of our illustrations shows a car which contained 42 tons of coal, and was the largest ever brought into the county. It was taken out 12 miles to a coal yard recently established at the terminus of the line. Several of these coal yards have been opened by local parties, and as many lumber yards, one alone of which will pay the road $1,500 in freight the present year. The company has also erected ample stock yards and is daily shipping all kinds of live stock of which there will be some 300 car loads this winter. To illustrate how such a line works as a feeder to a steam road, and as a creator of business, may be mentioned a recent shipment of 25 car loads of baled hay, which was sent into Chicago, but which it would not have paid the farmers to have hauled 10 miles into town to the nearest market, even had there been a demand there for any such amount. The same with milk: a farmer cannot afford the time and expense of hauling his milk eight and 10 miles to a railroad shipping point, so has been delivering it to local factories; but since the electric line opened nearly every farmer along the line has erected a platform in front of his house, and here are set out the cans of milk which the milk car picks up and delivers to the steam road at 7 a.m. each day. At 10 o'clock, just four hours from the time it left the farm, it is in Chicago and being delivered to consumers. As the city price is considerably in excess of that paid by the local country factories, the benefit to the producers amounts to a very considerable sum in the course of the year. Other farm products have been raised and shipped which never before were possible on account of lack of rail transportation, and the variety and volume of this business will increase largely each season. Another advantage is the improved mail service; two mails each way daily to Chicago against one, one way, when the service was furnished by teams. The daily papers were quick to take advantage, and a hundred copies of Chicago papers are now distributed at 7 a.m. each day where previously they arrived 24 hours old and consequently few were taken. Thus it will be seen the freight business, which has only been mentioned in a few of its most important branches, is destined to constitute a large part of the winter earnings, and there is no reason to doubt that within a few months the revenue from the milk freight alone will pay the entire bond interest of the road.

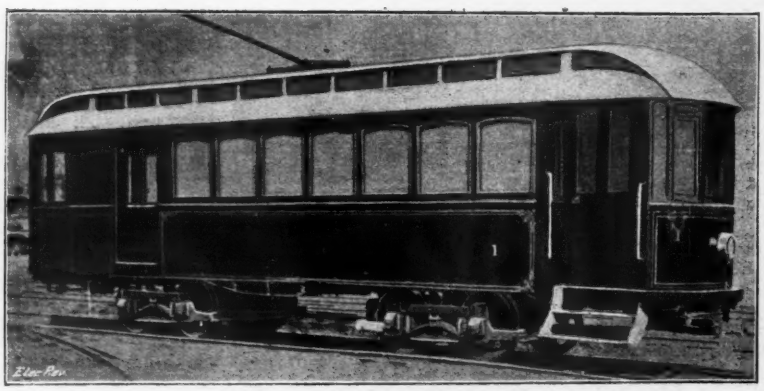
As to its physical construction, little is left to be desired. The Lorain Steel Company furnished the rails, which are 60-lb. T in 62-feet lengths, laid on ties spaced 20 inches centres. The rails are bonded with Atkinson bonds. Very fortunately there were no other roads or streams to cross. The switches were made by the Paige Iron Works, and are automatic. The overhead work is extra strong; the trolley wire furnished by the Western Electric Company is 00, and the feeders 0000. The brackets were from the Ohio Brass Company, side pole construction being used except through towns where the track is laid in the middle of the street. Trains are operated on a telephone dispatching system from the main office which is at the power station in Walworth.



Car House.




Delivering Coal.



Car.

The power house is a substantial brick structure 50×100 feet with a fire wall separating the boiler and engine rooms. A battery of two boilers made by the Murray Iron Works supplies two engines: one a 200-H.P. high-speed Ball and the other a 300-H.P. Providence Greene Corliss. The generators are 200 and 220-KW. Westinghouse, belt connected. At the switchboard 600 H.P. is easily indicated. The car house is a frame building adjoining, 50 × 125 feet, with three tracks. It is connected with the station by a system of both water and steam pipes for fire protection. The repair shop is also frame, and is 40 × 50 feet in dimensions.

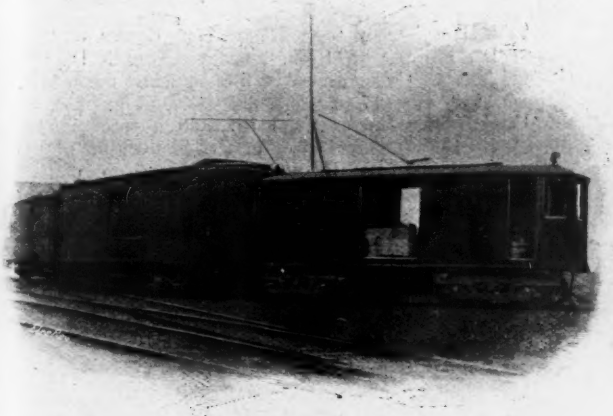
In the power house and along the line are some 20 Garton lightning arresters.

The equipment includes both summer and winter cars. There are two combination baggage and passenger cars 40 feet long on Brill trucks and Griffin wheels, built by the Jackson & Sharp Company.

The car seats 36 passengers and leaves ample room for trucks, light freight and express. These cars are equipped with two G.E. 57 motors and have a rated speed of 40 miles an hour, although this has been considerably exceeded on occasion. Two 40-feet passenger cars with G.E. 1,000 motors on McGuire trucks, one double truck parlour car, and two 24-feet single truck motor cars complete the passenger motor equipment. The freight locomotive is on McGuire trucks and hauls 100 tons at a load. All the motor cars are equipped with Christensen air brakes and whistles. There are also six open trailers for excursion business in summer. Although it was impossible to complete the line in time for much excursion business the past summer, several were handled, one of 1,000 passengers. The Meaker portable fare register is used.

At the lake terminus four acres on the shore have been secured and large docks built from which all the public steamers on the lake sail. Restaurant and depôt buildings have been erected here with facilities for taking care of large crowds.

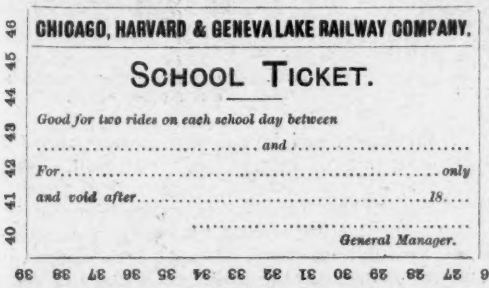
While the passengers and freight are at all times sufficient to pay operating expenses and interest, the summer traffic to the lake coming from Chicago and the surrounding cities and country will tax the road to its utmost. Owing to delay in completing the line on account of difficulty in getting construction material shipped, only a small part of the business offered could be handled last summer, and that after two of the best months were past. Notwithstanding this, the road with two passenger cars as its entire available rolling stock, in six weeks not only paid operating expenses for that period, but cleared 10 months bond interest, and this with the further handicap of construction work still in progress. The earnings for the lake period next summer are conservatively placed at $20,000. While the road has cost nearly $150,000 to build, it has been bonded for only $100,000. These bonds run 20 years, and are first mortgage gold bonds drawing 5 per cent. With interest charges of only



FREIGHT TRAIN.

$5,000, and operating expenses of $10,000 per year, the expectation of the projectors that the line will clear 10 per cent. on its capital stock of $150,000 has every prospect of being realised.

Quite a considerable business arises from children and young people going into town to attend the public and high schools and business college. For these a school ticket has been placed on sale so arranged that at time of sale as many rides are punched out as equal the holidays, &c., in the month for which it is sold. This saves printing a different ticket for each month. A similar arrangement is made to carry whole families from their farms to the several churches along the line; this is found to work very nicely and secures a large amount of riding which otherwise would be lost. The local cash fare over the line is 30 cents each way; round trip, 50 cents; 10-ride commutation tickets 40 cents for the round trip.



CHICAGO, HARVARD & GENEVA LAKE RAILWAY COMPANY.

SCHOOL TICKET.

*Good for two rides on each school day between*

..... *and* .....

*For*..... *only*

*and void after*.....*18*....

.....

*General Manager.*

The construction has given a wonderful stimulus to everything along the line. Farm properties have advanced in value; the people now attend the theatre and other gatherings, and social visits of both individuals and societies along the line are rapidly increasing. At Walworth, where the power station is located, over 30 new dwellings have been built during the past 90 days, and the demand is still larger than the supply.

The company also has valuable lighting and power grants, and it will put in a lighting plant to supply some 2,000 incandescent lamps at the lake for the coming summer.

The construction work was in charge of H T. Windsor, who is now managing the road. The president is W. F. Furbeck, of Chicago, for many years vice-president of the Yerkes lines in this city; and the treasurer, A. L. Dewar, of Chicago.

## JOSEPH HENRY.*

BY CUYLER REYNOLDS.

OWING to Joseph Henry's position in the history of American science, it has been deemed advisable by the citizens of Albany fittingly to celebrate the anniversary of his birth on December 17th, as he was born in that city 102 years ago. A few years from now all evidence will be either hearsay or that which is contained in books. To-day there live a few

JOSEPH HENRY.

who recall him as he was far back in the century, when, as a vigorous young man with residence in Albany, N.Y., he astonished the world by the success of some of his greatest works.

Few men of his time have been so active as was Henry during three-quarters of a century. When contemplating the long list of inventions, most of them world-famous, placed to his credit, it is cause for wonder, intermingled with admiration, that one man was able to do so much and do that remarkably well. Faraday's experiments in electricity established his name, never to be erased from the roll of great men; but one finds, in reviewing the life-work of Henry, equally as many and as valuable inventions, or more properly speaking, additions to the sum total of scientific knowledge of the world, the product of a wonderfully organised mind. There were bright minds here and there, in Great Britain, France, Germany, and Italy, at work upon similar lines of scientific development. Each made discoveries of great value, but the sense of satisfaction must be great to-day to every American to read that Henry antedated each of them. They worked until they produced something new, but Henry was like a combination of all of them, and, moreover, preceded them in each case. A report coming from Europe, by slow process in those days, when there was limited interchange of thoughts between two continents, of some striking invention, would be met by the printed paper on the same subject from Henry, showing that none could equal him in his march.

* *Scientific American.*

Prof. Joseph Henry was born in Albany, N.Y., December 17th, 1797, and spent the greater part of the first 35 years of his life there. It was there that he attended school, in the Albany Academy, organised in 1813, being one of the 92 pupils first enrolled. His grandparents on both sides came to this country from Scotland, landing on June 16th, 1775, the day before the battle of Bunker's Hill. When seven years old he went to Galway, Saratoga County, to reside with his maternal grandmother, and he continued there some time, as his father died before he could make any other arrangements for young Henry's future. He was sent

Induction Coils used by Henry to Investigate the Discharge of Leyden Jars, Princeton University Museum.

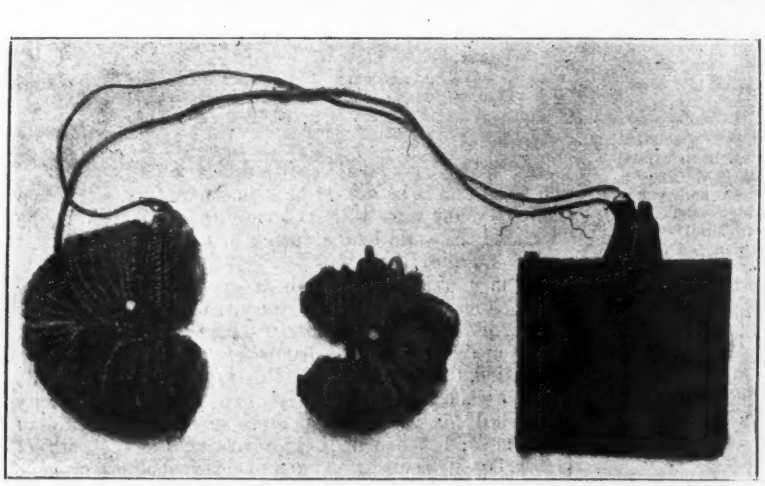
to the district school, where Israel Phelps was master, and at 10 entered the service of Mr. Broderick in his village store, but through the latter's kindness was allowed to attend afternoon sessions of the school.

When 15 years of age he returned to Albany to enter a watchmaker's shop. Strange as it may seem to those who realise how modest and retiring was his character in later years, he shortly gave way to the inclination, aroused by attending his first play on a visit to Albany, and cast his lot with theatrical people. For this he spent all his spare money and became an expert in preparing stage mechanism. Perhaps this was but a second stepping-stone towards the combining of materials in scientific instruments. He joined the private theatrical association in Albany styled "The Rostrum," and the originality of his scientific effects gained somewhat of a reputation for him. When the watchmaker left Albany young Henry had free rein to follow his vocation, dramatised a tale and produced a comedy. What a contrast to his other papers for 50 years after! A second accident, but this a physical one, confined him to the house, where he continued his acquaintance with books. These were philosophical works which he took up, and they produced a train of thought that effaced recollection of the stage. It was then the serious thinking of his life commenced and marked his coming to the Academy as an advanced student under Dr. T. Romeyn Beck; but he was obliged to pay his way by teaching in a district school. Then he became an assistant in the Academy, and again a private tutor in the family of General Stephen Van Rensselaer. In 1826 he was engaged in a surveying expedition under the State, and laid out a road through the southern countries. Had the appropriation for continuing similar work passed, Henry might have continued as a successful surveyor; but it did not, and this brought him to the turn in the road again that led to success as a scientist. The vacant chair in mathematics and natural philosophy in the Academy was offered and accepted, and his researches dated from that time. He associated himself with the Albany Institute while a tutor in General Van Rensselaer's family, the latter being the president of the Institute, and Henry's first paper, presented October 30th, 1824, when he was 26 years old, was: "On the Chemical and Mechanical Effects of Steam." He illustrated this by apparatus prepared by himself. He demonstrated a striking paradox, that the jet of steam will not scald the hand at a prescribed near distance from the jet, provided the steam be sufficiently hot.

Prof. Henry's home was 105, Columbia Street. The location is within sight of the new Capitol, perhaps 300 yards distant. It struggled hard, apparently, to survive its century of usefulness, for the old house was torn down this centennial year, after appearing for 10 years in most dangerous condition.

Among Henry's early friends were Hon. George W. Carpenter, Dr. Philip Ten Eyck, Thomas Hun, M.D., and Orlando Meads. Carpenter was at first a student under him, then, in 1828, when 17 years old, first assistant engineer in the United States service, and in 1830 a tutor in the Academy. He not only helped in the preparation of the apparatus for the test of the telegraph, but was one of that select group present when the demonstration was made. Mr. Carpenter is still living, and resides in Albany, sound in body and in mind, although in his 89th year. He states from personal knowledge that it was in the north-west corner of the basement of the Academy that Henry had his laboratory. The first experiments, however, were conducted in a room upstairs. The wire was strung about the ceiling of this room, and in one window was placed the apparatus, consisting of magnet and small bell. Many wrongfully suppose, from historical accounts, that it was the tinkling of this bell that thrilled the audience—certainly a gathering not appreciative of what was being manifested—but the bell itself did not move. It has a brass clapper, but the sound was produced by the striking of a steel rod against it. This little bell, that played so important a *rôle*, is now owned by Miss Caroline Ten Eyck, of Albany.

The bell measures $1\frac{5}{8}$ inches in height and $1\frac{3}{4}$ inches in width at the mouth. It served as a part of a sounder, and as Mr. E. N. Dickerson remarked, some years later, in a lawsuit,



The First Magnets with Several Layers of Insulated Wire, 1828.

Bell used in the First Telegraph Experiment, 1830.

"the thing was perfect as it came from its author, and it has never been improved from that day to this as a sounding telegraph." More striking still was the remark that the idea of Morse of impressing an alphabet upon strips of paper was abandoned, and people have gone back to the way Henry demonstrated it in the Academy that day, reading the signals by sound. This test was made in 1830. What led up to this discovery was his experiment with magnets. He commenced the study in 1828, exhibiting before the Albany Institute a small-sized electro-magnet closely wound with silk-covered copper wire (see engraving). The former plan had been to insulate the bar or core. By his compact method he obtained more turns, which were also more nearly at right-angles with the magnetic axis, and thereby gained greater power. To Henry the world is indebted for having first constructed the magnetic "bobbin," which has come into universal use in electro-magnetism. In 1830, assisted by Dr. Ten Eyck, he tried larger bars of soft iron, and about one he wound 540 feet of copper wire in nine coils of 60 feet each, which coils surrounded the branches of the horseshoe. By properly connecting the pairs of wires he obtained a wonderful increase in power. This magnet was suspended in a rectangular wooden frame. The lifting power was 650 lbs., and only a single battery was used, consisting of two concentric copper cylinders with zinc between, the zinc surface measuring only two-fifths of a square foot, with only half a pint of dilute acid.

Evidently Henry was aroused to make researches by the strong desire to expound before his class more than was contained in the text-books. The late Prof. James Hall, the renowned geologist, attests what has been said about the invention of the telegraph from his own experience, in the following words, after describing the arrangement of the circuit:—

**And at one termination of this, in the recess of a window, a bell was fixed, while the other extremity was connected with a galvanic apparatus. You showed me the manner in which the bell could be made to ring by a current of electricity transmitted through this wire; and you remarked that this method might be adopted for giving signals by the ringing of a bell at a distance of many miles from the point of its connection with the galvanic apparatus.**

It is entirely unnecessary to indulge in discussion of the precedence of the Henry and Morse early developments of the telegraph, for the matter was decided by a committee of the Smithsonian Institution, whose business it was to investigate, and which determined that Henry was the originator, and more forceful even than this is what Morse said regarding how he commenced his experiments three years later than Henry's practical demonstration.

*(To be continued.)*

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

25,591. "Repeater for wireless telegraphy." E. GUARINI. Dated December 27th. (Complete.) (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 27th, 1899, being date of application in Belgium.)

25,594. "Improvements in and relating to the process of galvanically inlaying metal on materials." F. EPPLER. Dated December 27th. (Complete.)

25,601. "Improvements in inspection and junction pieces for electric wire conduits." A. W. PRENTICE. Dated December 28th.

25,621. "Improvements in electric light switches." A. P. LUNDBERG and G. C. LUNDBERG. Dated December 28th.

25,622. "Improved method of fitting the covers of electric light fittings to their base parts." A. P. LUNDBERG and G. C. LUNDBERG. Dated December 28th.

25,628. "Improvements in electric fishing apparatus." I. W. J. LINDBOHM. Dated December 28th.

25,641. "Improvements in electro-mechanical accumulators." H. W. SCHLOMANN and A. DE CASTRO. Dated December 28th.

25,681. "Improvements in and connected with electro-dynamometers." V. I. FEENY. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated December 29th. (Complete.)

25,688. "Improved apparatus for electro-therapeutic treatment." J. J. STANGER. Dated December 29th.

25,698. "Improved apparatus for automatically controlling the light of electric gas and other lamps." C. E. H. KEDDIE and E. SOLMERSITZ. Dated December 29th.

25,699. "Improvements in or appertaining to electro-motors." G. J. GIBBS Dated December 30th.

25,701. "An improved controlling apparatus for electric motors." J. A. STEVEN and W. R. HAIGH. Dated December 30th.

25,709. "Improvements in electrically-driven cranes." F. H. ROYCE. Dated December 30th.

25,710. "Improvements in electrical apparatus for opening gas cocks from a distance." R. J. URQUHART. Dated December 30th. (The Actien-Gesellschaft für Fabrikation von Bronce-waren und Zinkguss vormals Spinn und Sohn, Germany.)

25,721. "Improvements in plates for storage batteries." A. PALLAVICINI. Dated December 30th. (Complete.)

25,730. "An improved electrical commutator." J. BRYANT, H. SMALLMAN, and A. H. ELSOM. Dated December 30th.

25,736. "Improved electrical igniting apparatus for internal combustion engines." E. SCHAEFFER. Dated December 30th.

25,740. "Improvements in current collectors for electrical machines." B. G. LAMME. Dated December 30th. (Date applied for under Patents, &c., Act, 1883, Section 103, June 5th, 1899, being date of application in United States.)

25,741. "Improvements in and relating to lightning arresters." A. J. WURTS. Dated December 30th. (Date applied for under Patents, &c., Act, 1883, Section 103, June 8th, 1899, being date of application in United States.)

25,744. "Improvements in dynamo-electric machines." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (H. G. Reist, United States.) Dated December 30th. (Complete.)

25,745. "Improved method of regulating dynamo-electric machines." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. P. Steinmetz, United States.) Dated December 30th. (Complete.)

25,746. "Improvements in alternating current electric meters." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. P. Steinmetz, United States.) Dated December 30th. (Complete.)

25,747. "Improvements in safety devices for dynamo-electric machines." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (H. W. Buck, United States.) Dated December 30th. (Complete.)

25,748. "Improvements in electric railway systems." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (A. H. Armstrong, United States.) Dated December 30th. (Complete.)

25,749. "Improvements in electric railway systems." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (W. B. Potter, United States.) Dated December 30th.

25,750. "Improvements in controlling electric motors." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (M. W. Day, United States.) Dated December 30th. (Complete.)

25,751. "Improvements in electric time switches." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. H. Van Slyck, United States.) Dated December 30th. (Complete.)

25,752. "Improvements in electric meters." BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. D. Haskins, United States.) Dated December 30th. (Complete.)

25,767. "Improvements in or relating to electric motors." H. ROWNTREE. Dated December 30th. (Complete.)

25,768. "Improvements in and relating to electric lifts or elevators." H. ROWNTREE. Dated December 30th. (Complete.)

### ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

#### 1897.

**16,764. "A new or improved electro-magnetic cut-in and cut-out." J. Luhne.** Dated July 15th, 1897. A cylindrical or annular receptacle containing a liquid conductor such as mercury, is oscillated by electro-magnetic devices when the current varies. The circuit is thus made and broken at the surface of the mercury. Two cylindrical blocks suitably pivoted, are formed with annular grooves containing mercury and vaseline oil, the faces being closed by glass plates. Within the grooves are arranged contacts which make or break the circuit when the cylinders are oscillated by the movements of the armature of the magnets transmitted through the lever and suitable gearing. Projections engage with a roller oscillated by the armature and serve to lock the apparatus in position. The conductors may be connected directly to the contacts or connection may be made through mercury cups and contacts also carried by the cylinder. 1 claim.

**16,774. "Improvements in electric appliances for medical and other purposes." H. Sancha.** Dated July 15th, 1897. It is stated that if a living organism be connected with another body in a different thermal or electrical condition by a moderate electrical conductor, rapid oxygenation or hydrogenation of the capillary blood is produced, and that this principle may be utilised for invigorating the organism and for preventing or curing disease. Numerous forms of apparatus are described for carrying the invention into effect. In one form it consists of a cylindrical metallic casing packed with copper or other metallic bars and supported by a yoke is heated by an atmospheric burner having a long narrow slit and attached by an insulating union to an ordinary gas fitting. One end of the cylinder is connected by a coiled spring and a conducting cable to a contact plate. The cable and contact plate are secured together by a plate to which are fastened the ends of a silk strap for application to various parts of the body. Instead of the cylinder and burner above described, a clip screwed on to any part of a stove or range or other source of heat may be employed. Another arrangement consists of a cylindrical metallic shell filled with a suitable electro-negative material, such as fused sulphur, which is exposed to a low temperature either by laying it on the floor or suspending it outside the window. Two application bands connected together may be employed for two persons sleeping in one bed. In connection with a house or building, several sources of energy may be employed, for example, a plate exposed to the sun's rays, an apparatus heated by a stove or fireplace, and another embedded in the earth; these are all connected to a common switchboard, from which proceed the connectors for the patient. Finally, an arrangement may be employed consisting of an absorbent cord, connected at one end to an application pad and at the other to a weight deposited in a vessel of water, which may be either cooled or heated. 28 claims.

**16,788. "Improvements in alternating current motor." W. L. Davies.** Dated July 15th, 1897. Relates to alternating current motors. In a self-starting alternating current motor having a distributed magnetic field, such as is described in Specification No. 18,870, A.D. 1895, the bars of the armature, instead of being set in a plane parallel to the axis of rotation, are set in a plane at an angle thereto. The bars may be arranged either in tunnels or in pheripheral grooves. Instead of the armature bars being set askew, the field magnet winding may be so disposed. A rotating field may be produced for starting the motor by the means described in Specification No. 7,772, A.D. 1897. 2 claims.

**16,797. "Improved controlling apparatus for accumulator batteries." G. J. Erischer and M. A. Bosso.** Dated July 15th, 1897. Relates to a commutator switch for controlling the action of a secondary battery. One set of cells are connected to pairs of contacts while the other set of cells are connected to a pair of contact bars. The movable portion of the switch is provided with two contact springs the latter of which is divided, with a resistance interposed between its parts to reduce sparking. By this arrangement the one set of cells can be switched into circuit seriatim and then the other group, to which can be added the former group seriatim. An arrangement in which a pair of switches, such as described, are employed to control the charging and discharging of a secondary battery. 3 claims.

**16,816. "Improvements in the construction of secondary batteries." H. Leitner.** Dated July 15th, 1897. A perforated lead plate surrounded by a frame is packed with active material of the kind described in Specification No. 780, A.D. 1896 and rolled into the form of a cylinder, the edges of which do not quite meet, to allow of expansion. This cylinder is placed in a casing of acid-proof resilient material, and is also lined with a perforated casing of similar material, the lining being attached to rings at the top and bottom of the cylinder. The negative electrode is preferably of the construction described in the above-mentioned specification, *i.e.*, an insulating rod is covered with lead on which zinc is deposited, and a conducting-rod rests on the insulating rod, which has also a triangular rubber block at its lower end. The negative electrodes are placed inside the positive electrodes, and a number of these cylinders are packed tightly together in a resilient case. In the provisional specification, it is stated that the electrolyte preferably used is that described in Specification No. 1,572, A.D. 1897. 5 claims.

**20,180. "An improved electrical accumulator." P. Brandt.** Dated December 9th, 1897. Relates to an accumulator consisting of a cell of porous clay, placed within a vessel of glass, &c., and divided into compartments by removable clay partitions. The teeth or lugs on the lead combs dip into alternate compartments. The compartments are filled with a paste consisting of an alkaline sulphate with a mixture of calcium oxalate or tartrate and sulphate together with sulphuric acid and litharge or other oxide of lead. Butyric acid and glycerine are added to the paste to accelerate solidification. 3 claims.

**27,495. "Improvements in starting devices for alternating current motors." The British Thomson-Houston Company, Limited. (W. J. Foster.)** Dated November 23rd, 1897. Relates to alternating current motors. For the purpose of increasing the starting torque of a synchronous current motor, a bridge of magnetic material formed with central slots is placed between every two of the polar faces of the field magnets. These bridges form closed circuits in which induced currents are set up, which assist in starting the motor. 4 claims.

**27,543. "Improvements in electric cables." J. D. Gould.** Dated November 23rd, 1897. In multiple cables the various conductors or bunches of conductors are differently coloured and are separated by a strand or cord of insulating material. Inside the strands is arranged a destructible insulating sheath containing a central core coated with lead. An ordinary outer coating is employed. In case of fire, the coating is destroyed, and the lead on fusing completes the alarm circuit. 3 claims.

**29,009. "Improvements in or relating to electric furnaces for the production of calcium carbide and other substances." J. Bastick and W. A. Thornton.** Dated December 8th, 1897. An arc furnace for making calcium carbide, or for other purposes, consists of a lined metal box carried by a table and reciprocated on horizontal guides by a connecting rod and crank, under a carbon electrode, this being revolved horizontally by a wheel through which its supporting rod passes eccentrically. The materials are fed in through channels in the outer casing of the furnace. At the bottom of the box is a carbon electrode, a tapping hole is closed by a plug on a weighted lever. One end or bottom of the box may be hinged and held up by a screw and hand wheel to permit it to be emptied. The box is carried by wheels on rails on the table, so that it may be removed; normally it is bolted on the table. Receptacles are movable on rails below the furnace. The outer casing is closed by doors with mica windows. The upper carbon is movable vertically by a wire rope passed over pulleys to a screw and hand wheel or a solenoid. It is enclosed in a shield, movable vertically by a rack and pinion as described in Specification No. 19,116, A.D. 1898. Several carbons may be used. In a modification the supports and furnace box are all movable vertically, the upper electrode being stationary; the feeding shoots may be reciprocated to spread the materials. 3 claims.

**29,010. "Improvements in or relating to means or apparatus for conveying the boxes to and from electric furnaces." J. Bastick and W. A. Thornton.** Dated December 8th, 1897. Relates to electric furnaces. A furnace box which may have a hinged end or bottom, or a movable plug for a tapping hole runs on rails, and is moved into or from the furnace casing, or reciprocated below an electrode by a chain or chains carried on wheels, one of which is rotated by a belt or pulley on its shaft when the belt is shifted from a loose pulley by a hand lever, or is oscillated by an eccentric and lever when this is connected to the shaft by a coupling movable by the same hand lever. Platforms are provided to receive the box. The furnace casing may be closed by lowering doors on the chains; these doors may have mica windows. A trolley runs on rails below. The electrode is enclosed in a shield, as described in Specification No. 19,116, A.D. 1898. 1 claim.

**29,011. "Improvements in or relating to electric furnaces for the production of calcium carbide and other substances." J. Bastick and W. A. Thornton.** Dated December 8th, 1897. In an arc furnace for making calcium carbide, or for other purposes, a lined metal box is supported below a revolving electrode by a hollow metal cylinder, which is screw threaded and movable vertically by a nut rotated on bearing brackets by a worm. Or the table may be moved vertically by a rack and pinion. The box is provided with a hinged bottom, or a tap-hole, and may be either circular or rectangular in plan. It is reciprocated circularly or rectilinearly upon the supporting cylinder by a horizontal connecting rod and a crank wheel rotated by a worm; a circular box may be rotated continuously by a worm. A trolley is movable on rails below the box. The electrode is partly enclosed in a movable shield, as described in Specification No. 19,116, A.D. 1898. 1 claim.

**29,024. "Improvements in and connected with reflectors and supports for electric glow lamps." J. Webster and W. Reynolds, jun.** Dated December 8th, 1897. Relates to supports for incandescent lamps. Lamps are provided with reflectors made of paper, card, or asbestos, lined with coloured or lacquered foil paper. For stage lighting and other purposes, rows of lamps are mounted on bamboos, in which the conductors are placed, as shown in section, and the lamps are shielded by wires and rods connecting rings in pairs. 3 claims.

**29,055. "Improvements in or relating to alternate current meters." C. P. Feldmann and Helios Elektricitats Aktiengesellschaft.** Dated December 8th, 1897. Relates to induction motor meters for use with alternating currents which are provided with thin patches of magnetic material on the armature or brake discs, in order that these may be definitely stopped by the adjacent magnets when the main currents through the meters are stopped. The magnetic material may be applied electrolytically or mechanically, in one or more strips on the disc. 1 claim.

**29,062. "Improvements in apparatus for the manufacture of electric cables." W. S. Smith and W. P. Granville.** Dated December 8th, 1897. Solid or air space insulated conductors are twisted into a cable with the strands forming sectors. In the case of a cable formed of two strands, two reels of conductor are mounted on to an ordinary twisting table which carries on its upper part four rings. The first ring has a central guide opening. The second ring carries two pairs of facing rollers, one of each pair being grooved while the other is cylindrical. The third ring has a pair of rollers provided with guiding discs on their adjacent edges to bring the flat parts of the strands together. The fourth ring has a pair of grooved rollers to form the two semi-circular strands into a circular cable. The various pairs of rollers are set at suitable angles to form the twist. 4 claims.

**29,065. "Improvements in syntonic telegraphy." O. J. Lodge and A. Muirhead.** Dated December 8th, 1897. Relates to a system of signalling by Hertzian radiations in which the receiving areas are bridged by parallel circuits including a coherer, an inductance, a condenser, and a receiving instrument and battery. These apparatus are grouped in various ways, including a Wheatstone bridge system, the coherer, inductance and condenser being arranged in two parallel circuits in one arm of the bridge. The receiver is across one diameter, and the battery across the other. A rotating cylindrical switch is described for automatically varying the circuits of the coherer so that the coherer is (1) connected to the receiving areas; (2) connected to the receiver signal circuits; and (3) connected to a decohering apparatus, either mechanical or electrical. An arrangement of the apparatus is shown in which the areas are provided with a spark gap and latch, which is opened for transmitting and closed for receiving. The apparatus is provided with a switch lever which in one position (receiving) closes the coherer contacts and connects the coherer to a rotating switch, while in the other position (transmitting) it opens the above circuits and closes the circuit, thus completing the induction coil and latch circuits. The signalling is preferably done through a relay circuit, either by key or automatic transmission. The coherer may be of any desired form, and is preferably contained in a metal box, the contacts being completed by wires which are withdrawn from the box or are provided with ends which plug the holes in the box. 6 claims.

**29,116. "Improvements in the distribution and regulation of electric energy and in conductors connected therewith." S. W. Baynes.** Dated December 9th, 1897. In order to regulate the pressure at the feeding points, without varying the generators, the feeders are divided into three sections, insulated from one another. Six switches are arranged to connect up the sections as required. The feeders may consist of cables having several conductors insulated from one another, or of bare conductors suitably divided. 3 claims.

**29,155. "Improvements in electric lampholders." E. L. Joseph.** Dated December 9th, 1897. Relates to holders for incandescent lamps. A flanged cylindrical insulator is made in two halves, and with recesses to receive two plunger holders which have been previously secured to the supply conductors by screws. These parts, having been put together, are placed in a metal socket and secured by a top piece and a screw-coupling sleeve. A projection on the socket enters a recess in the insulator to prevent turning. One half of the insulator may have a protection fitting into a recess in the other, between the plunger holders. 1 claim.

**29,236. "Improvements in electrical switches." J. Moore and H. O. Farrell.** Dated December 10th, 1897. Relates to an electric switch consisting of a drum or cylinder revolubly mounted on a spindle which carries a contact bar adapted to connect the contacts. The cylinder is rotated by a lever the inner end of which slides in a spiral groove. In another arrangement, the lever is forked and embraces a spiral ridge on the cylinder. To secure pressure on the contacts the spindle may slide in slots and be spring-controlled. Springs may be fitted to give a fly action. 2 claims.

**29,244. "Improvements in apparatus for freeing lighting, and extinguishing gas burners at a distance by means of electricity." P. Guyenet.** Dated December 10th, 1897. Relates to a means for lighting and extinguishing gas. A ball, preferably of steel, is shown as closing the outlet of the gas supply passage. An electric current causes a platinum wire which bridges two wires to glow, and also causes the core of the electro-magnet to attract the ball allowing gas to pass to the pilot burner pipe and to the burner pipe. As soon as the gas is ignited, the circuit may be broken and the ball drops on to the seating and closes the pipe while gas is still supplied to the main burner. To extinguish the gas another electro-magnet is excited by the arrangement of a special switch and the core attracts the ball, which drops into the seating immediately the circuit is broken. 4 claims.

**29,251. "Improvements in and connected with connections for storage cells." E. J. Wade and the Electric Motive Power Company, Limited.** Dated December 10th, 1897. In order to prevent corrosion of the metal bolt used to connect together the lugs of secondary battery plates, flanged ebonite washers are fixed in the holes in the lugs, through which the bolt passes. The provisional specification states that the insulation may be effected by covering the metal surfaces with a layer of enamel or of vulcanised rubber. 2 claims.

**29,273. "Improvements in plates or electrodes for electric accumulators." H. H. Lake. (C. Francke.)** Dated December 10th, 1897. The positive and negative plates of lead and like accumulators are formed with upwardly-curved ribs. Ribs of various forms may be employed, and they may be grooved and the surface cut into ridges like a file. 3 claims.

**29,306. "Improvements in apparatus employed in wireless telegraphy." G. Marconi and the Wireless Telegraph and Signal Company, Limited.** Dated December 10th, 1897. Relates to improvements on the apparatus described in Specification No. 12,039, A.D. 1896. The coherer is enclosed in a thick metal box with one or two openings through which connection can be made. Only one opening is employed when one coherer terminal is connected to the case itself The opening or openings is or are closed by a shutter or shutters operated by the lever which carries contact clips connected to earth through a strip and contacts connected to the insulated area through the strip and flexible wire. The position shown is for transmitting, the openings being closed and the spark gap balls being in circuit. For receiving the lever is reversed, when the coherer is placed in circuit. When only one aperture is employed the contacts on the lever are suitably modified. 2 claims.

**29,318. "Improvements in and connected with the control and regulation of electrically propelled vehicles." E. J. Wade and the Electric Motive Power Company, Limited.** Dated December 11th, 1897. Relates to means for controlling and regulating electrically propelled vehicles, storage cells are joined in shunt across the field-coils of the series-wound motors. The electromotive force of the cells and resistance of the coils are proportioned so that when the normal magnetising current is passing through the main circuit, no current flows into or from the cells, so as to produce a braking action or to give additional power. 1 claim.

**29,361. "Improvements in or relating to electric gas lighting and controlling devices." J. H. Kerridge.** Dated December 11th, 1897. Relates to a means for lighting and extinguishing gas. The gas valve is controlled and the gas is ignited, electrically. Upon passing a current in one direction through the electro-magnets the armature is drawn downwards against the action of the spring. A disc valve and the attached permanent magnet then fall, and are rotated by attraction of the electro-magnets. Gas thereupon passes to the pilot-jet and to the main burner, the pilot jet being ignited by a platinum wire in the electric circuit. When the current is cut off, the spring lifts the armature and the disc valve, thereby closing the bye-pass pipe. But gas continues to pass to the main burner until an electric current is sent through the apparatus in the reverse direction, when the armature is again lowered and the disc valve rotated, so that, on cutting off the current, the valve is lifted and closed by the spring. By means of a channel in the valve seating, gas can always pass to a pipe controlled by a hand valve to permit of the burner being used, notwithstanding any breakdown of the electrical apparatus. This apparatus is carried by a stirrup which is screwed to the lid to facilitate its removal, and the gas supply may be so arranged that it does not traverse the chamber. Asbestos or other packing is provided to ensure a tight joint between the cover and the superposed parts. 6 claims.

**29,377. "Improvements in or relating to the propulsion of railway trains and the like by electricity." E. Kasselowsky.** Dated December 11th, 1897. One or more motors are mounted on some or all of the vehicles in a train, and are supplied with current from a generating plant carried on one of the vehicles. Suitable electric couplings connect the vehicles, and all the motors may be controlled from a single point. Accumulators may be carried on the train to store current during stoppages or on down gradients, &c. 2 claims.

**29,390. "Improvements in electrical apparatus for transmitting and receiving predetermined messages." Siemens Bros. & Co., Limited, and C. Holden.** Dated December 11th, 1897. Relates to order telegraphs for hotel and other purposes which consist of instruments having double indicating dials for the various wants and their replies placed in the apartments. These instruments are connected at the central to indicators, a resistance, relay, bell, and battery. On receipt of a call the switch cuts out the resistance relay and bell, and places the instrument in direct circuit with the vibrator. The instruments consist of an escapement mechanism which is moved by a pointer to the required order when the plunger is depressed. As soon as the wheel is moved contact is closed at the terminal and on releasing the plunger the call is sent. When the attendant has thrown over the switch required, the circuit is closed and the vibrator producing intermittent currents causes the instruments 1, 2, 3, to move backward, and the instrument to move forwards until the circuit is broken by the pin at the terminal. To transmit the reply, the instrument is used as above described for the instrument 1, 2, or 3, and the pointer of the latter instrument is turned round through a circle so that it can move back to the desired signal. 4 claims

**29,493. "Field telephone and telegraph stations." M. Bernstein.** Dated December 13th, 1897. Rifles have the stocks made hollow and lined with metal so as to receive a dry battery, telephone, induction coil, and key. One side of the stock is formed as a lid to which the telephone is fixed. The lid forms a bracket or table when the bayonet is stuck in the ground. The battery connections are completed when the lid is opened. The line is carried on a reel carried in the knapsack. 1 claim.